Sustainable Pest Management Lab
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Nematode Management with Organic Approaches

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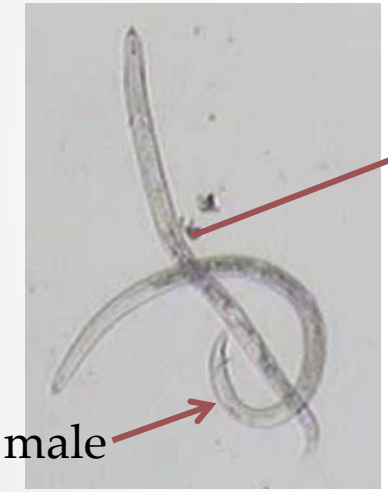
Nematode Damage on Sweet Potato

- Currently, sweet potato (*Ipomoea batatas*) generated the highest farm gate values among staple crops in Hawaii, approximately $7.3 million in 2011 (up 13% from previous year) (NASS, 2012).
- Sweet potato weevil (*Cylas formicarius*) could account for 30-97% yield loss.
- Reniform nematode (*Rotylenchulus reniformis*) has been reported to cost 24% yield loss on sweet potato (Abel et al., 2007).

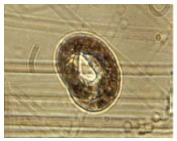
Reniform Nematode (Rotylenchulus reniformis)

Pre-adult female

slightly swollen



male



anhydrobiosis

Difficult to manage (can survive in dry fallow soil for years)

Kidney-shape female

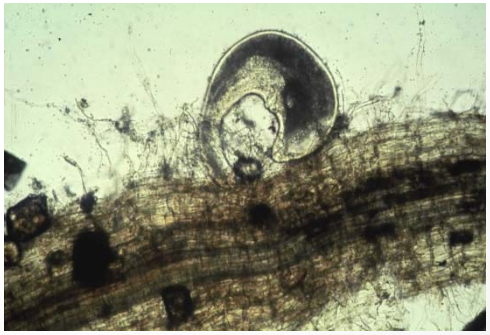
J4

J3

Vermiform stages stay outside of roots

J2

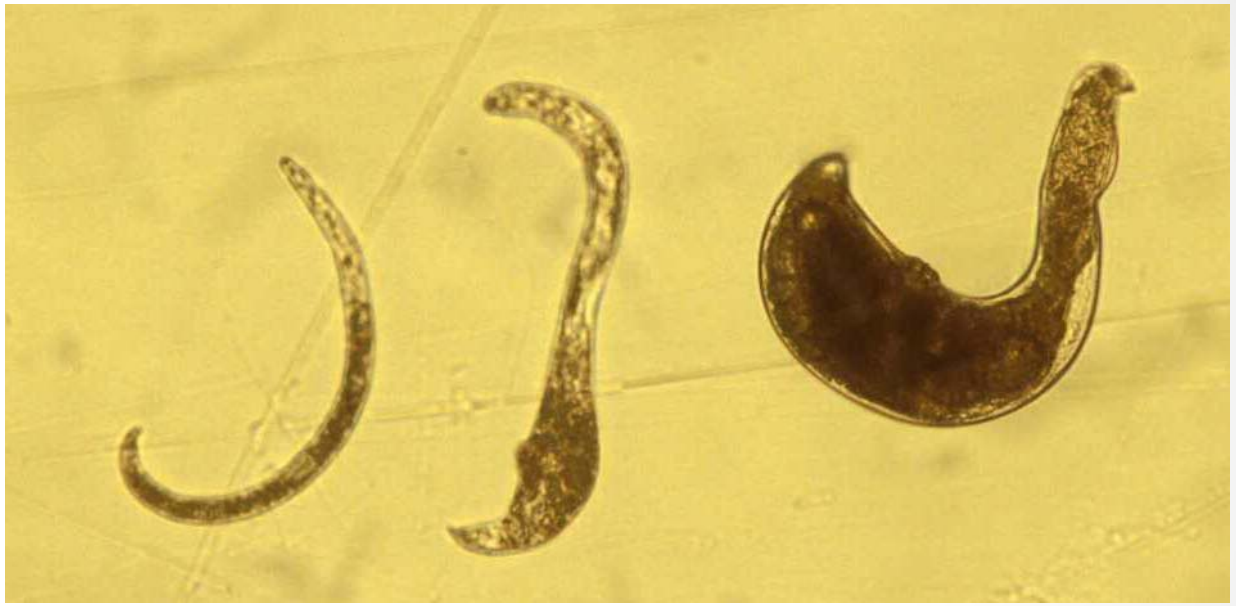
egg



- Easy to manage

Crops in Hawaii most Susceptible to Reniform nematode

Pineapple



Papaya

Cowpea

Sweet potato

Damage of Reniform Nematodes on Sweet Potato

Uninfected tubers

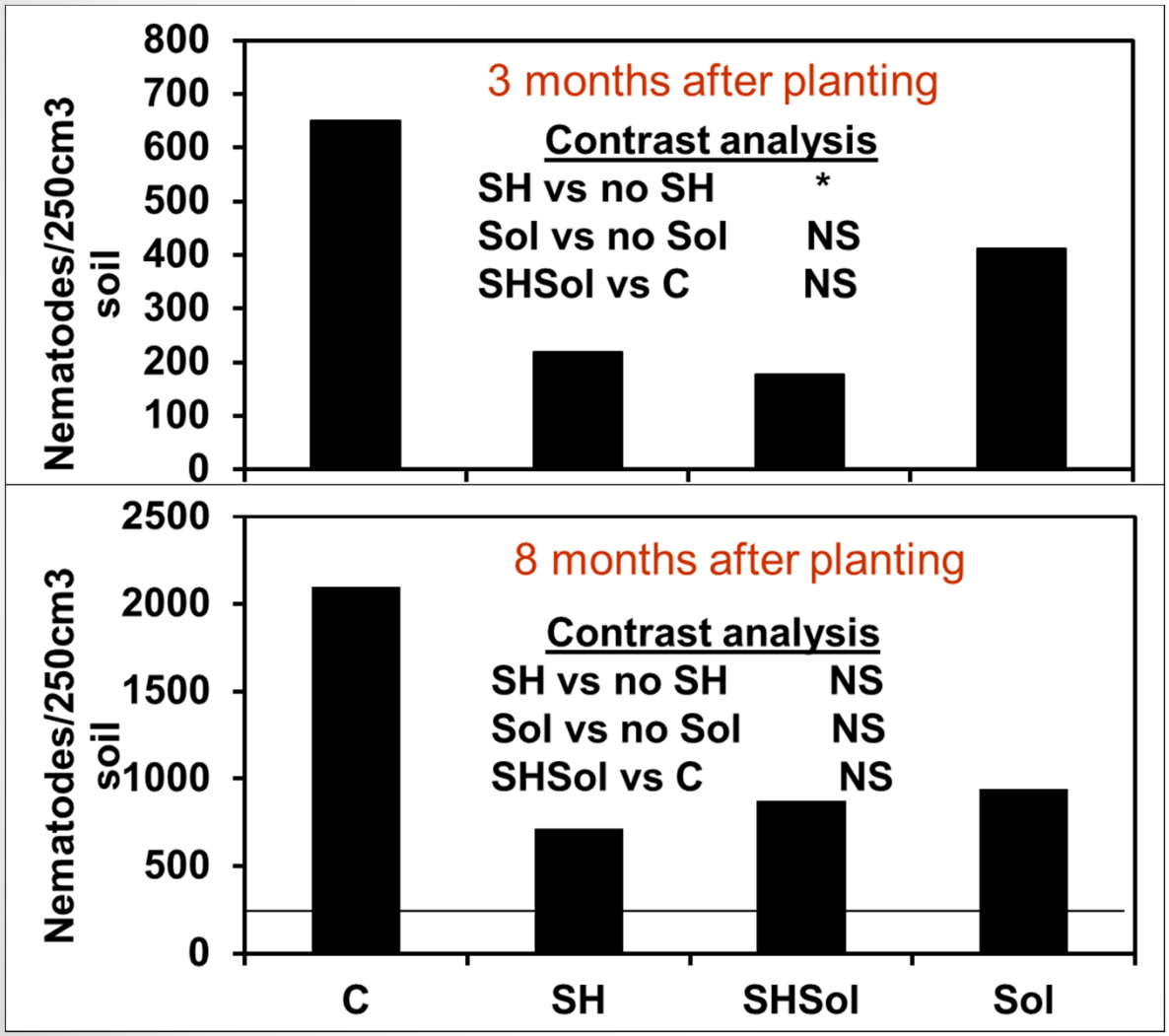
Tubers infected with reniform nematodes

The reniform nematode causes root necrosis resulting in severe root pruning, stunted plants, and cracking on the tuber.

Outlines

- ✓ Pre-plant soil treatment
- Post-plant soil treatment
  - Integrating sunn hemp and organic post-plant soil drenching treatments (sweet potato)
  - Integrating solarization with post-plant nematicide (pineapple)
  - Other biologically based nematode management strategies

Sunn Hemp is well known to be suppressive to Reniform and Root-knot nematodes



C = Bare ground control
SH = Sunn hemp
Sol = Solarization
SHSol = SH+Sol

Planting of sunn hemp significantly suppressed reniform nematodes 3 months after pineapple planting.

Mechanisms of Sunn hemp (Crotalaria juncea) to Suppress Plant-parasitic Nematodes

1. Serves as a poor host
2. Produce allelopathic compound against plant-parasitic nematodes when incorporated into soil
3. Produce organic matter, can enhance nematode-trapping fungi
4. Enhance beneficial nematodes and soil arthropods involved in soil nutrient cycling, thus increase plant tolerance

- Legume, fixes nitrogen.
- Rapid growing, 4 -10 tons dry biomass / acre, 163 lb N/acre at 60 days of growth (40 lb seeds/acre) during summer in Hawaii.

Do SH age, tissues, or biomass amount affect SH allelopathic effects?




1 month **2 month** **3 month** **4 month**

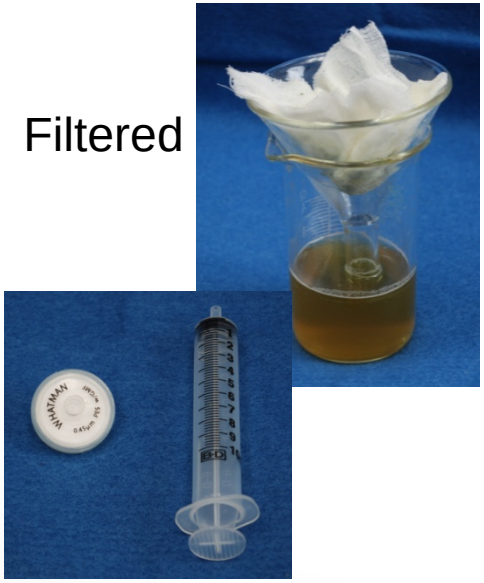
4 ages ×	4 tissues ×	5 Concentration
	Leaf	2.5%
	Stem	1.0%
	Flower	0.5%
	Roots	0.1%
	Whole plant	0

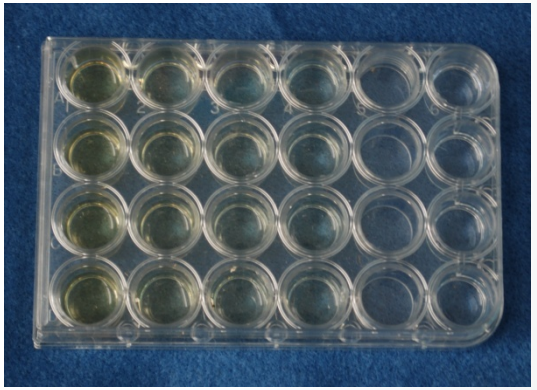
4 dishes
2 trials

Sunn hemp Allelopathic Assay

Soaked in water – 24 hr

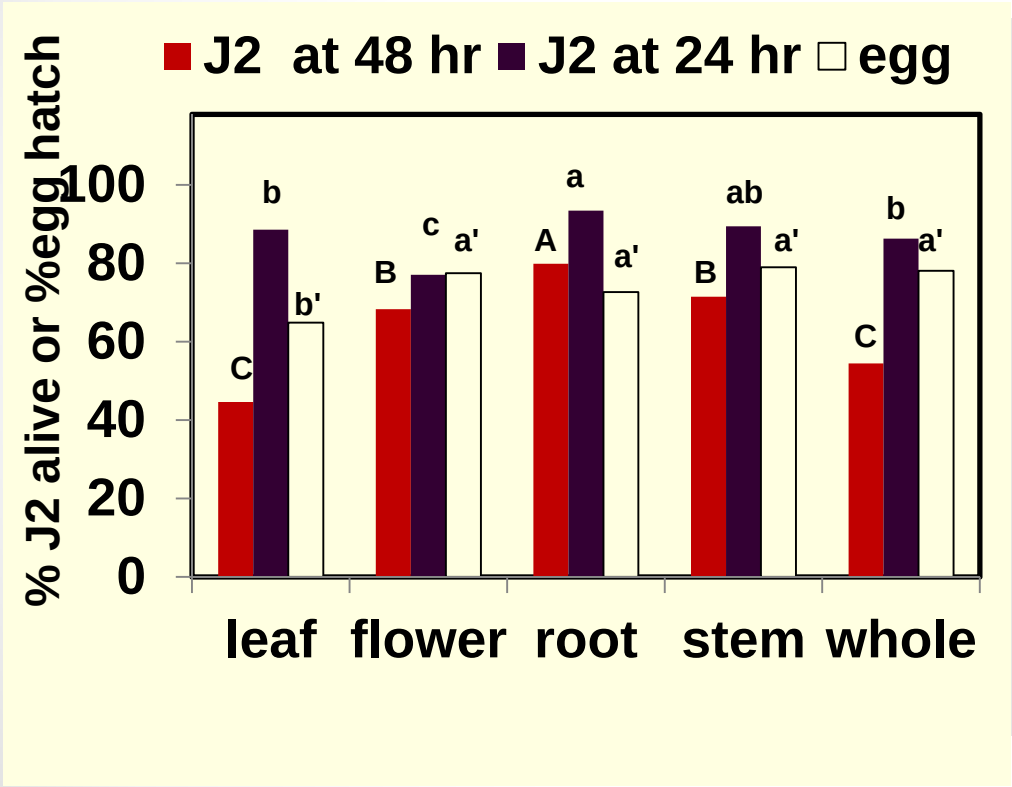
Filtered





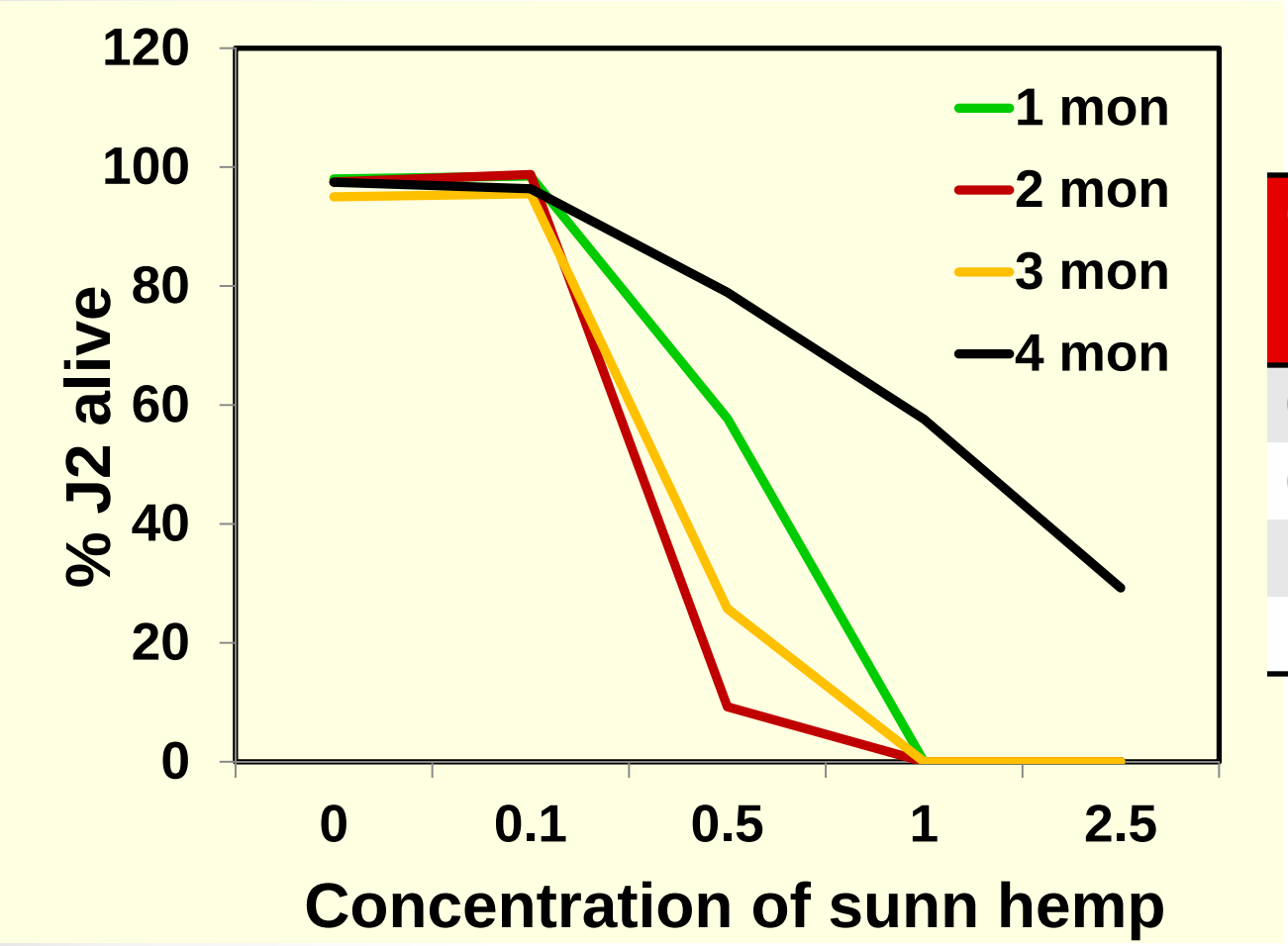
+100 root-knot nematodes juveniles (J2)
+100 eggs

Effects of SH tissues



- Leaf tissue was most suppressive, and the result resembled those in the whole plant tissues.
- The suppressive effect is just nematostatic.
- Leachate had minimum effect on egg hatching.

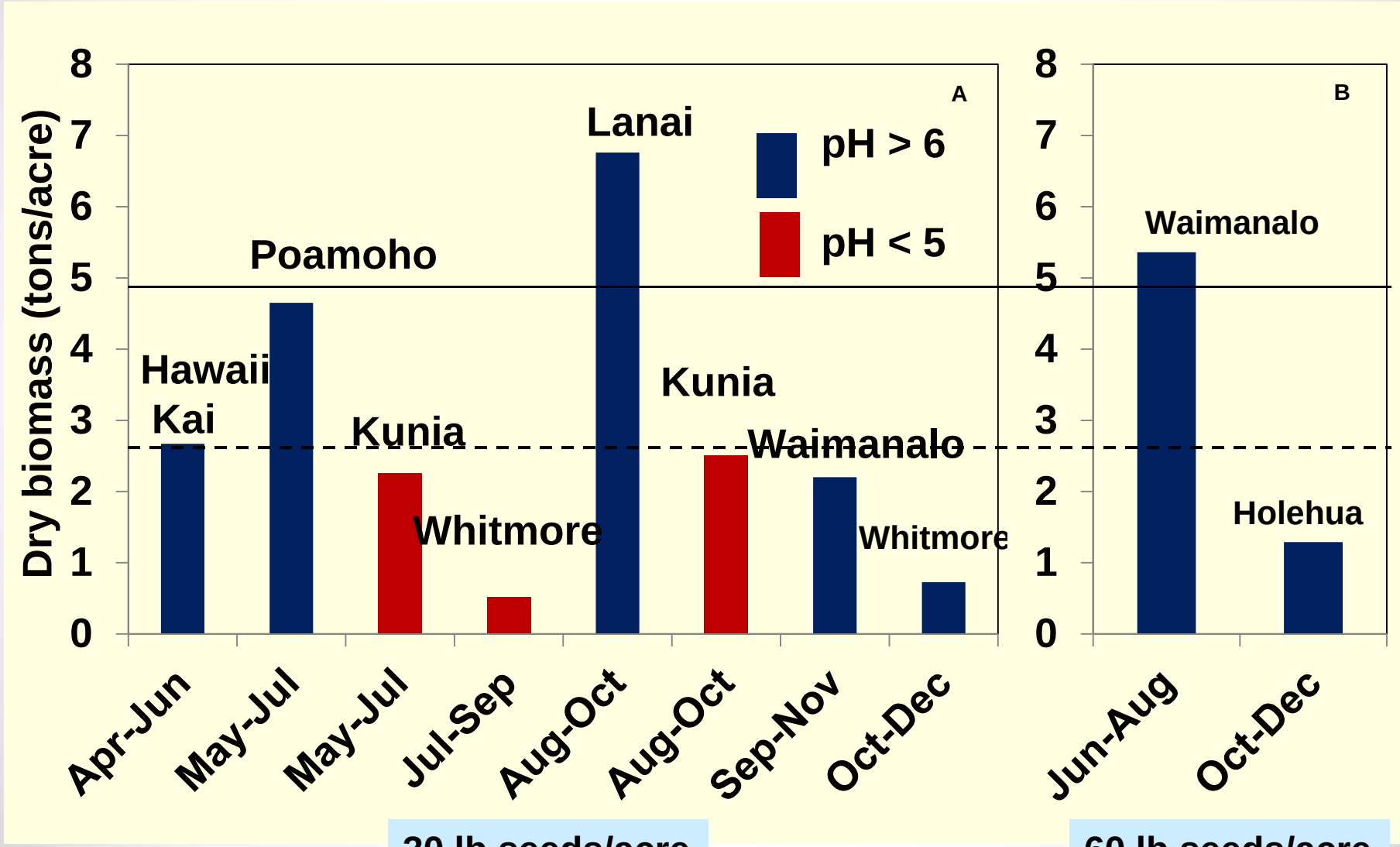
Effects of SH age and Biomass Amount



Conc (%)	Dry Biomass (tons/acre)
0.1	0.5
0.5	2.5
1	5
2.5	12.5

- 1% concentration paralyzed *M. incognita J2* completely.
- 0.5% paralyzed > 75% of J2s of *M. incognita* if SH is 2-3 months old.

Biomass of 2-3 month-old Sunn Hemp commonly seen in Hawaii



Implication for Sweet Potato farmers

Fallow could knock down the population number of reniform and kill off infected sweet potato.

Plant sunn hemp during spring or summer for 2 months (in soil pH > 5) with irrigation, till in sunn hemp biomass (preferred 5 tons/acre) before planting sweet potato.

Outlines

Sunn hemp Superhero needs some friends

- Pre-plant soil treatment
- ✓ Post-plant soil treatment
  - Integrating sunn hemp and organic post-plant soil drenching treatments
  - Integrating solarization with post-plant nematicide (pineapple)
  - Organic post-plant nematode management?

Integrating SH with Post-Plant Drenching

Integrating SH with Post-Plant Drenching

Sunn hemp (SH)

No Sunn hemp (NoSH)

Transformer

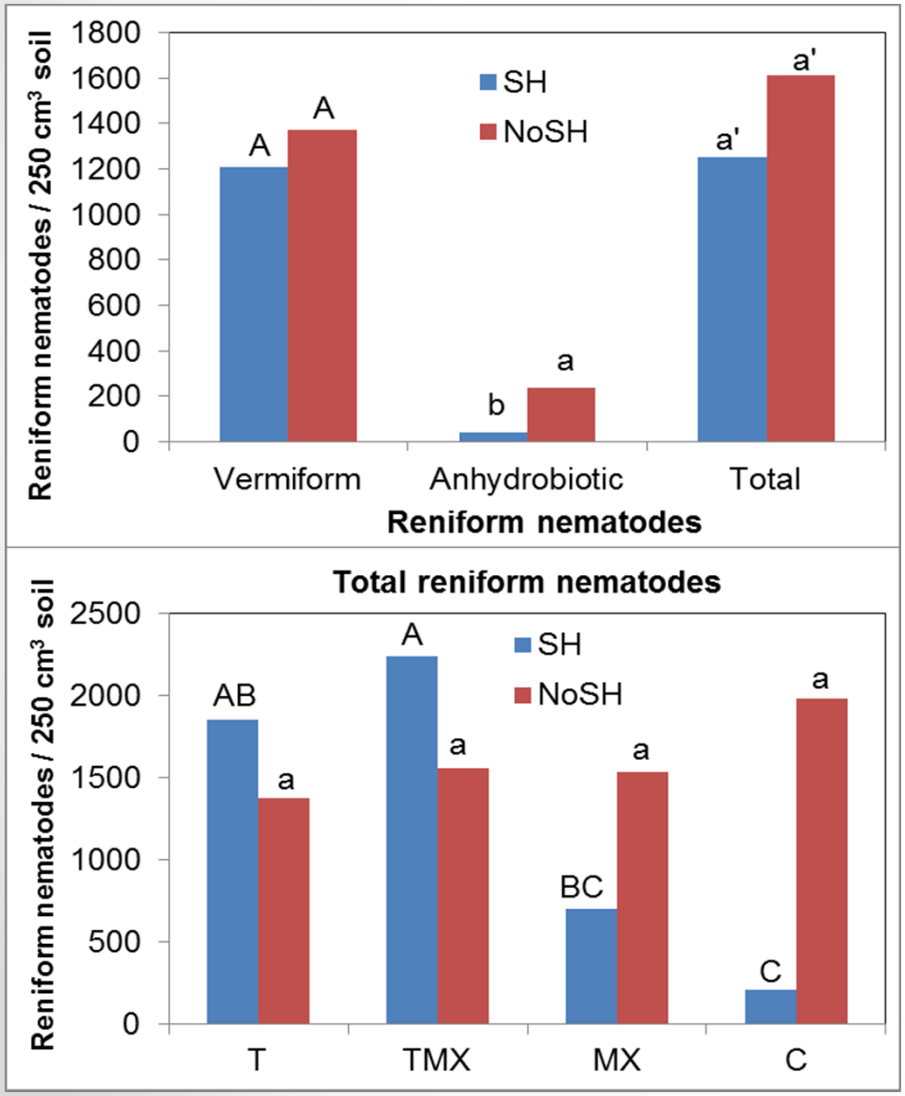
Control (C)

(TMX) Transformer®+Molt-X® a.i. alcohol ethoxylate

T = Transformer (1 gal/acre) once
MX = Molt-X (15 oz/acre)/month
C = Untreated Control

Molt-X® (MX) a.i. neem

Integrating SH with Post-Plant Drenching

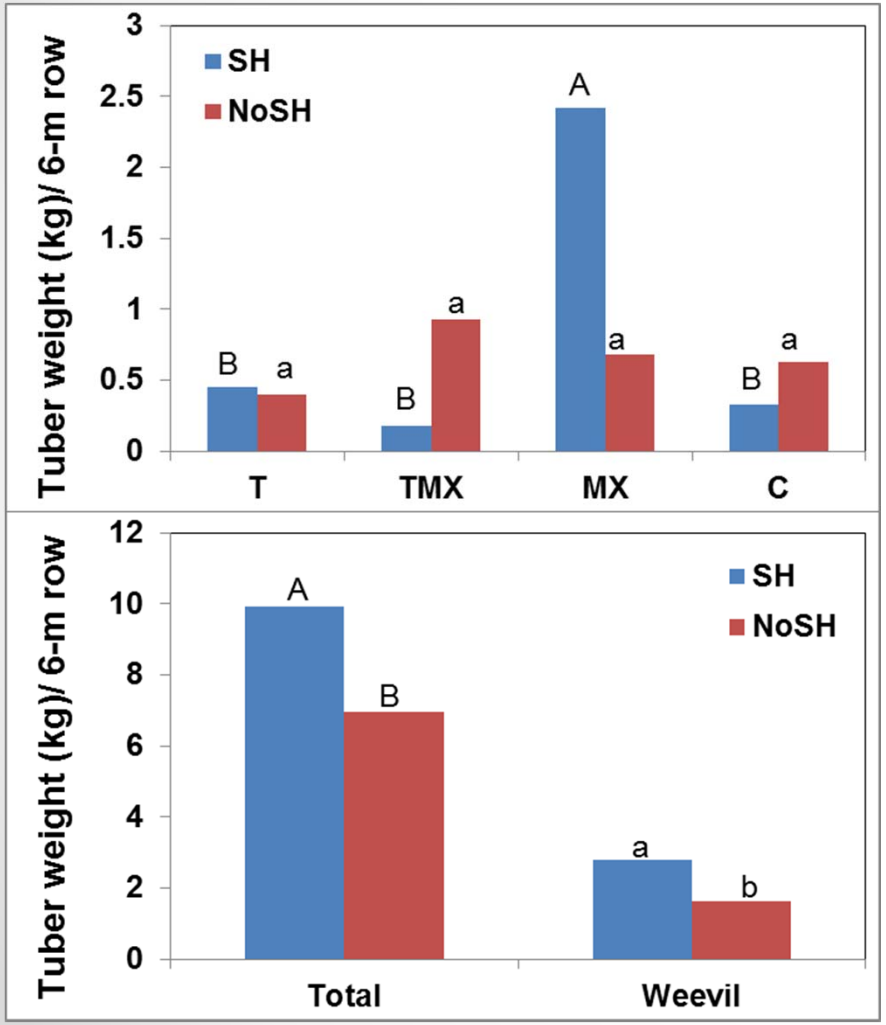


At 3.5 months after sweet potato planting (harvesting),

- Planting of SH only significantly reduced anhydrobiotic reniform nematodes.
- Drenching of Molt-X and Untreated C had the lowest reniform nematode numbers.

T = Transformer (1 gal/acre) once
MX = Molt-X (15 oz/acre)/month
C = Untreated Control
n =4

Integrating SH with Post-Plant Drenching



- SH increased total sweet potato tuber weights ($P < 0.05$).
- Drenching of Molt-X only increased sweet potato weight if drenched in SH plots (7.3 × higher than C).
- C had low nematodes but also very low yield.
- Farmers need to control sweet potato weevils by other means.

Molt-X is an effective post-plant nematode management.

Outlines

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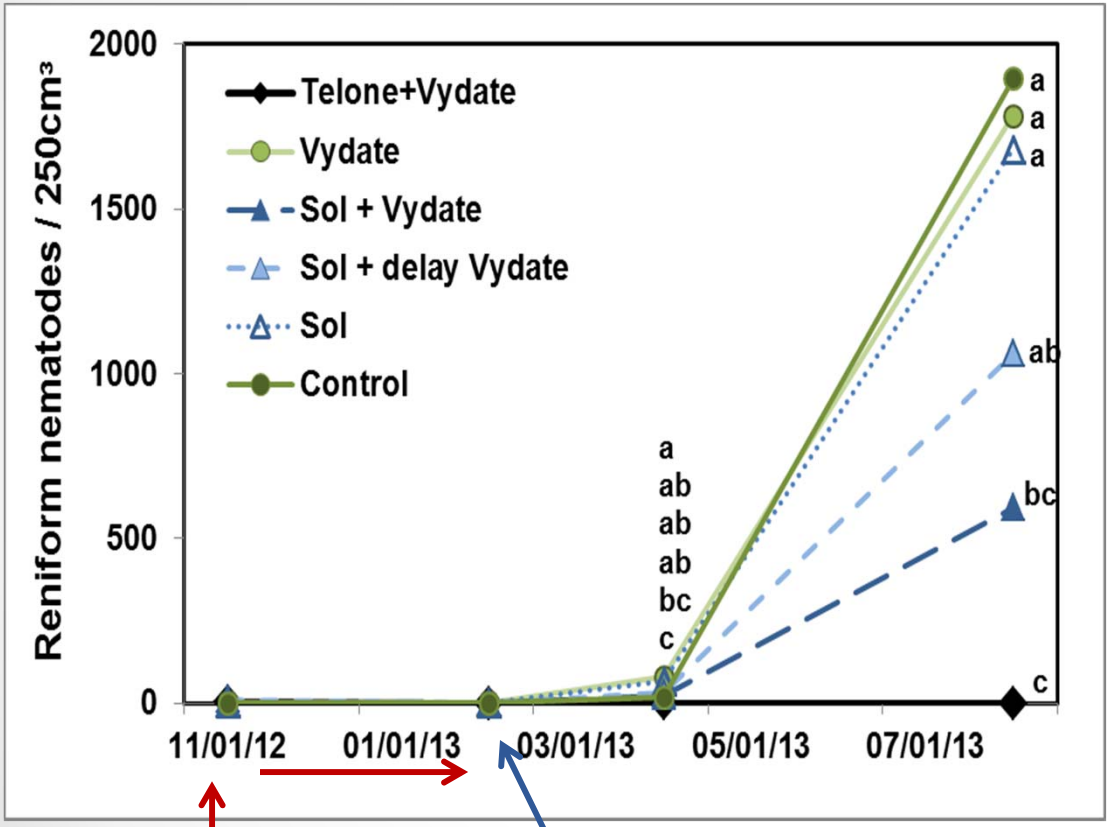
  - ✓ Integrating solarization with post-plant nematicide (pineapple)
  - Organic post-plant nematode management?

Solarization

Cover the soil with clear plastic (1 mil) for 4-6 weeks, heat up the top soil layer to 35-60°C (95-140 ° F).

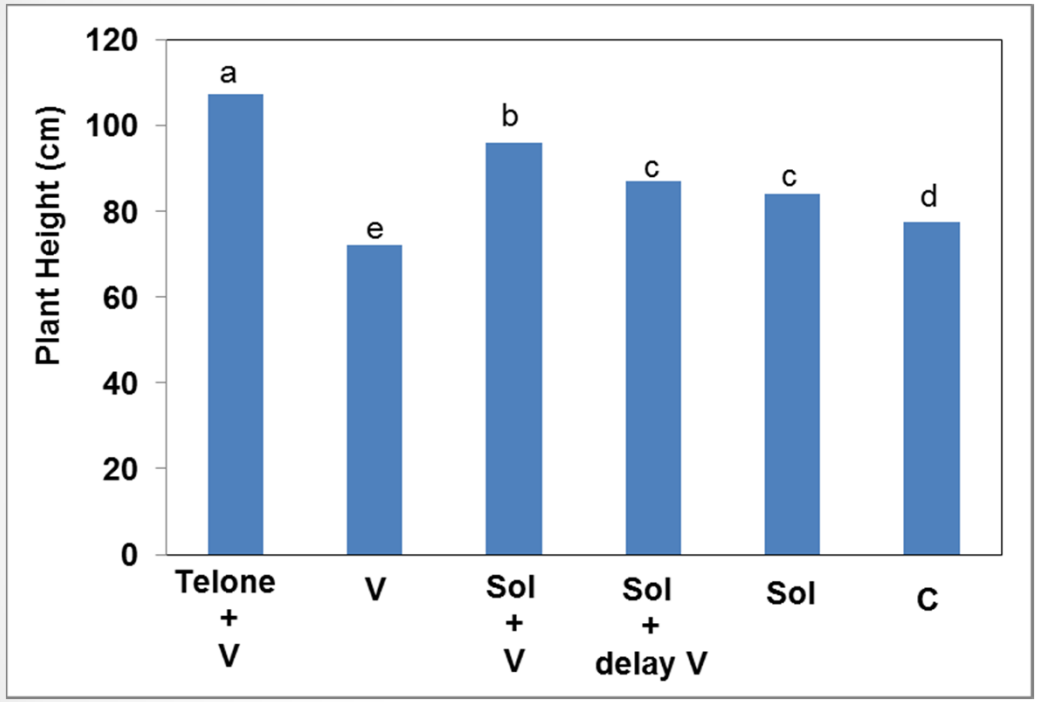
Solarization and Post-plant Nematicide (Vydate)



At 7 months after pineapple planting,

- Sol + Vydate suppressed reniform nematodes to level similar to Telone + Vydate.

Solarization and Post-plant Nematicide (Vydate)



Pineapple canopy at 6 months after planting

- All solarization treatments promoted better pineapple growth at 6 months after planting than Vydate (V) alone or the untreated control.

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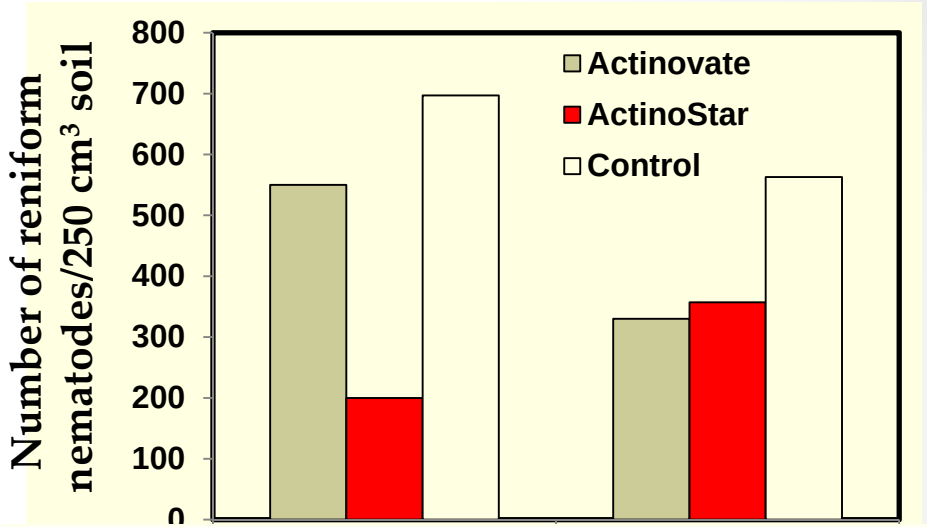
  - ✓ Organic post-plant nematode management

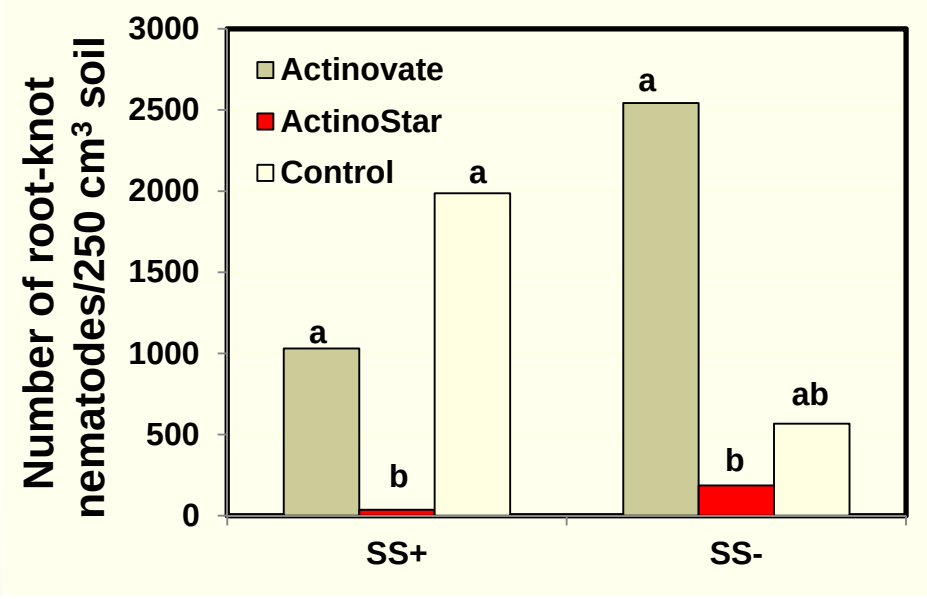
- **Actinovate AG** is a high concentration of a patented beneficial organisms on a 100% water soluble powder.
- a.i. = Streptomyces lydicus strain WYEC 108
- An effective preventative spray for many soil-borne and foliar fungal diseases.
- Effect on nematode suppression is not convincing.

- 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 can suppress root-knot nematodes if integrated with 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)





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Western SARE Project
No: SW08-037