



Nematode Management for Small-Scale Sweet Potato Production

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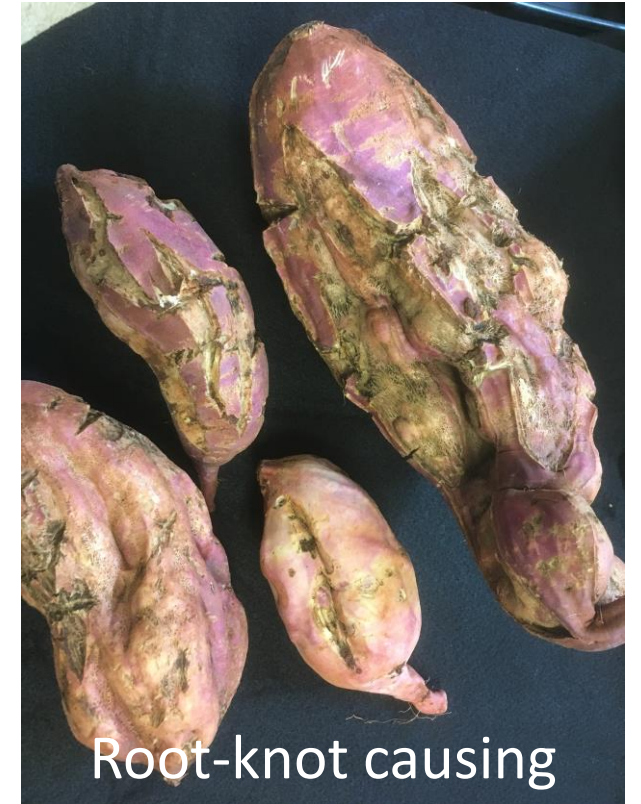
Reniform and Root-knot Nematodes are both damaging to Sweet Potato



Healthy



Delay in storage root development caused by reniform nematodes



Root-knot causing root cracking

These nematodes causes root necrosis resulting in severe root pruning, tuber cracking, dwarfing of the plants, cracks on swollen roots, or severe crop failure.

Threshold root-knot @100/100 cm³ soil, reniform = 200 /100 cm³ soil at planting.

Reniform nematode has a broad host range

Prefer soil with high clay content



Pineapple



Papaya



Cowpea

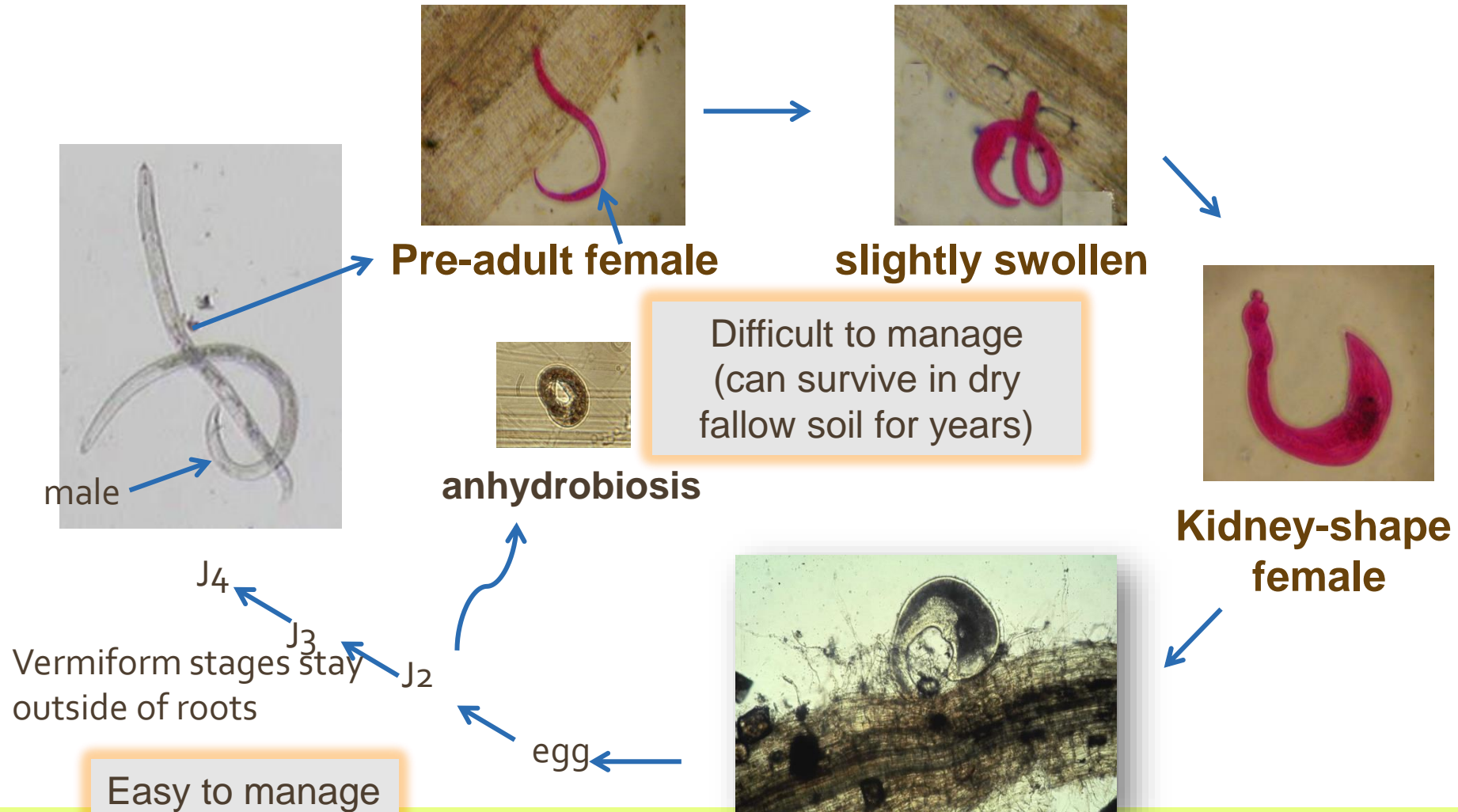


Sweet potato

...and wide range of vegetable crops

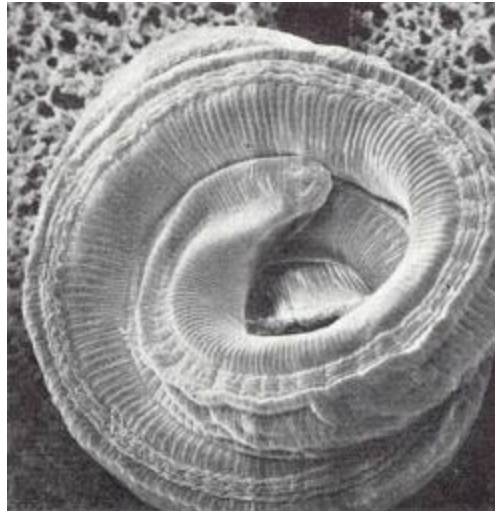


Reniform Nematode (*Rotylenchulus reniformis*)



Anhydrobiosis

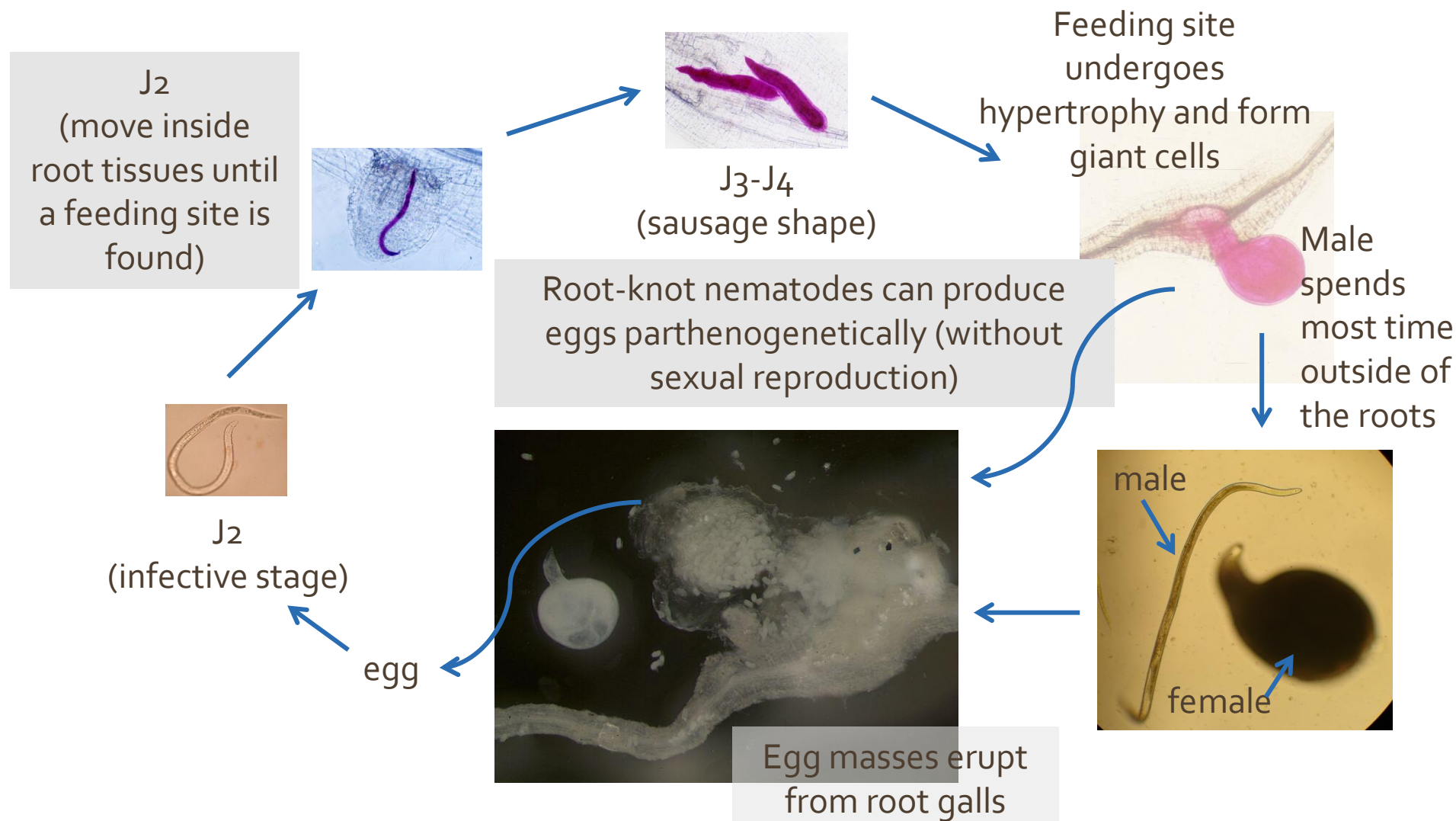
= Some nematodes can survive the loss of all their body water and enter a state of anhydrobiosis in which their metabolism comes reversibly to a standstill.



Scanning electron micrograph of a nematode after dehydration.
(Sugar Team, http://coursewares.mju.ac.th:81/e-learning47/PP300/0016sugarteam1014/5605nematode/004%20under%20microscope/page_01.htm)

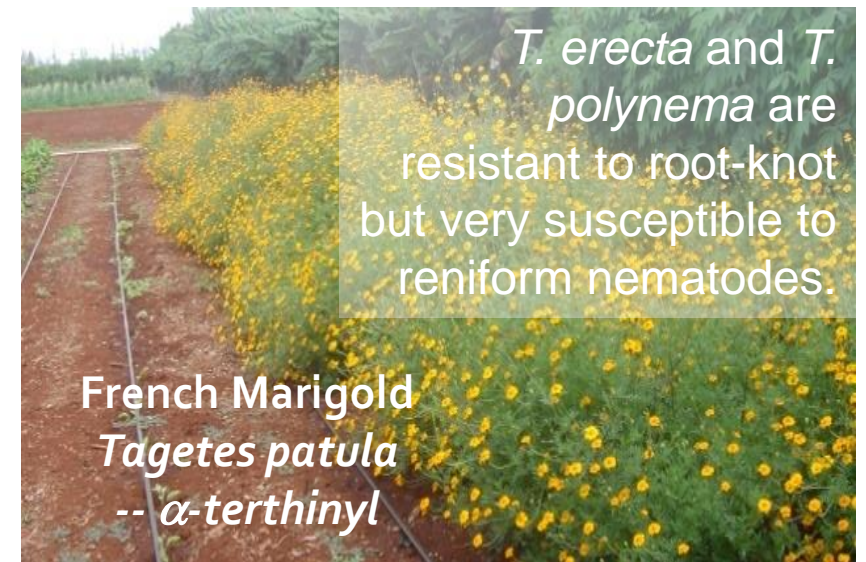
This is making reniform nematode very difficult to manage.

Root-knot nematode (*Meloidogyne* spp.) is more damaging than reniform nematodes on sweet potato especially in soil with higher sand content

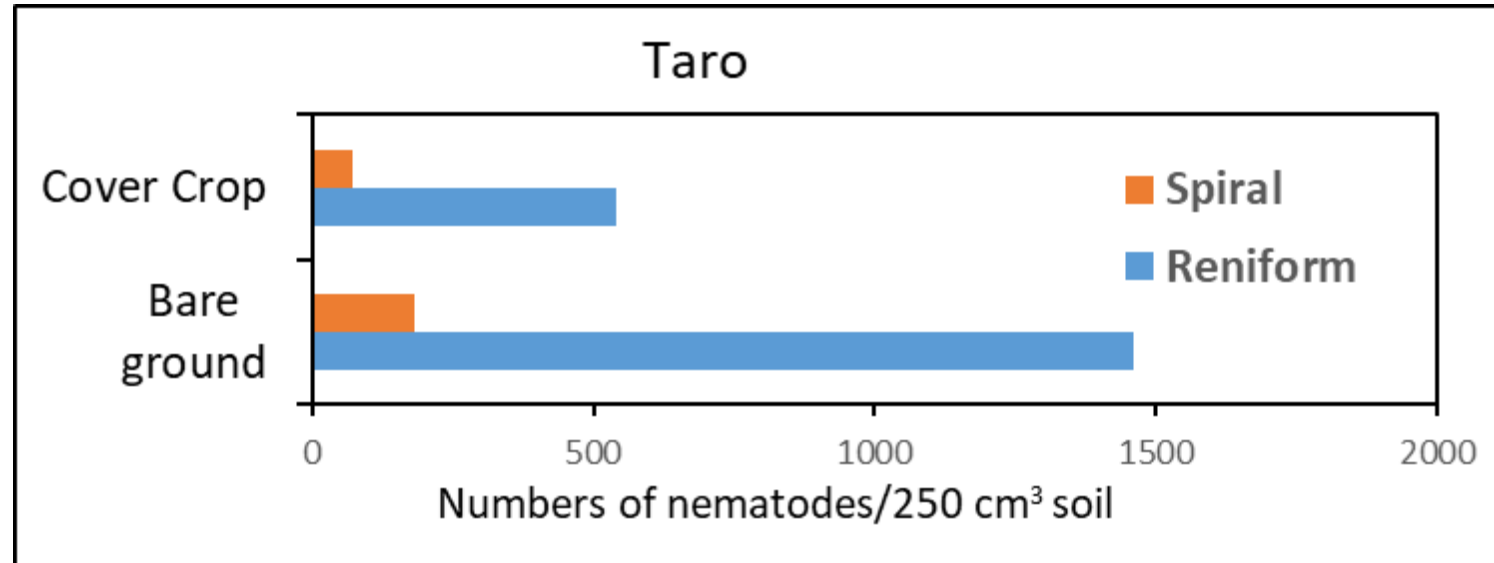


Management options

- ✓ • Allelopathic cover crops
- Crop rotation
- Resistant sweet potato varieties
- Nematicides:
 - Pre-plant
 - Post-plant



2019 Kauai Cover Crop Trial



- Cover crop:
- Sunn hemp
 - Buckwheat
 - Cowpea

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https://www.lsuagcenter.com/portals/communications/publications/publications_catalog/crops_livestock/insect_disease_control/vegetables/nematode-management-in-louisiana-sweet-potato-production



Table 2. Host potential of several crops to nematodes in Louisiana.

Crop	Reniform	Root-knot
Sweet potato	Yes	Yes
Cotton	Yes	Yes
Corn	No	Yes
Wheat	No	Yes
Soybean	Yes*	Yes†
Grain sorghum	No	Yes**
Fallow	No	No

*Most varieties are susceptible to reniform or root-knot nematode. Occasionally, there are some varieties that may have some resistance.

**Grain sorghum varieties that are currently grown in Louisiana have been found to range from moderately susceptible to moderately resistant to root-knot nematode.

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Table 1. Screening Data from 2010			
	Egg Mass Index	Gall Index	Eggs Per Plant
Susceptible			
Beauregard	2.8	5	440,000
Orleans	2.3	4.8	440,000
Intermediate			
Bayou Belle	0.5	3	90,000
Resistant			
Covington Jewel	0	2.5	50,000
Highly Resistant			
Bellevue Bonita	0	0	2,300
Burgundy Evangeline Murasaki-29	0	0	4,600

Table 1. Reactions of major sweet potato varieties to race 3 of the southern root-knot nematode, *Meloidogyne incognita*. Data are from greenhouse screening in 2010: gall and egg mass indices are on a scale of 0 = none up to 5 = more than 100 per plant.

(Smith et al., 2017; LSU)

Kauai Experiment Station



2019 Screening Sweet Potato Varieties



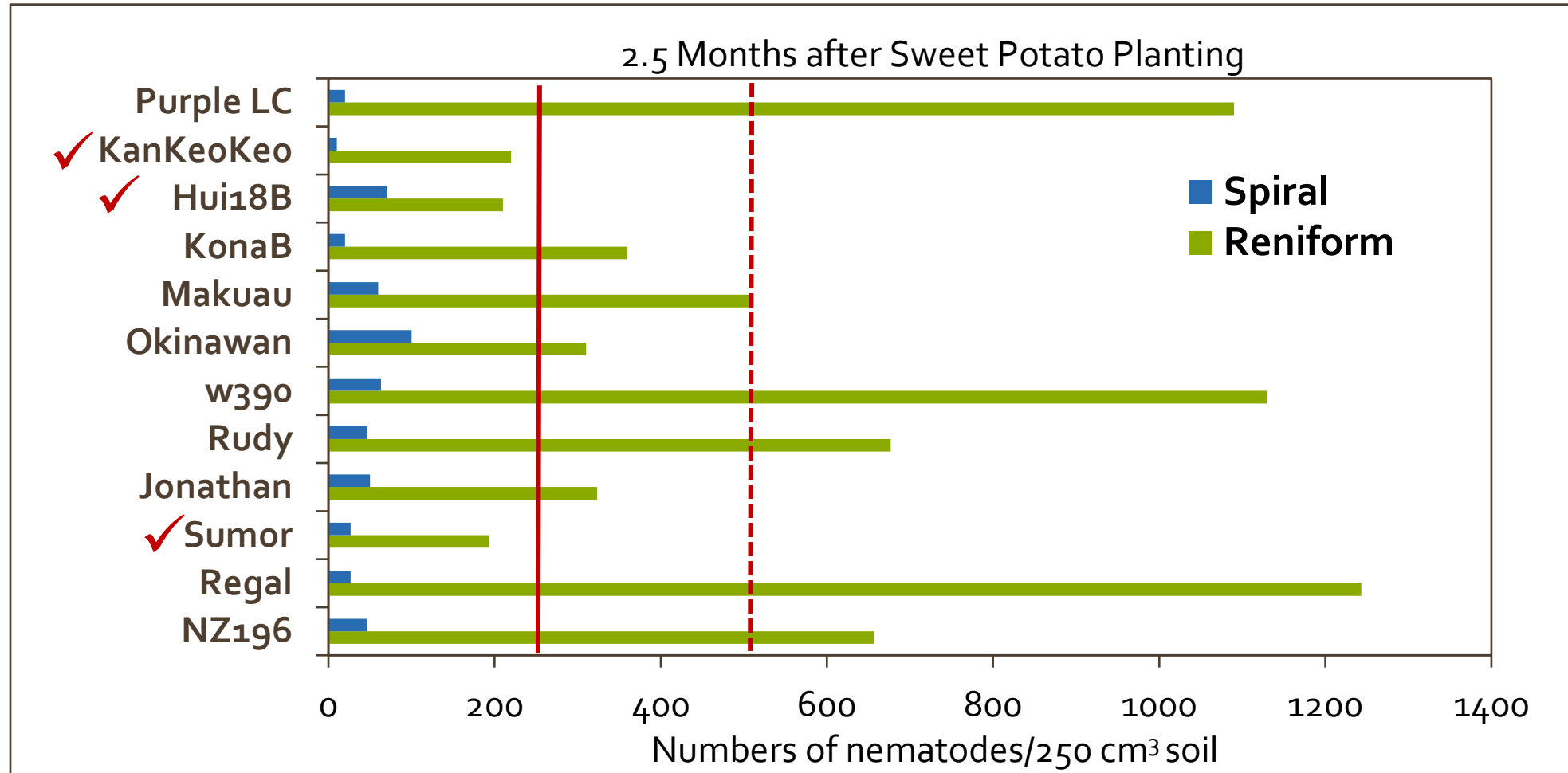
Preliminary screening of sweet potato varieties against reniform nematodes



Reniform



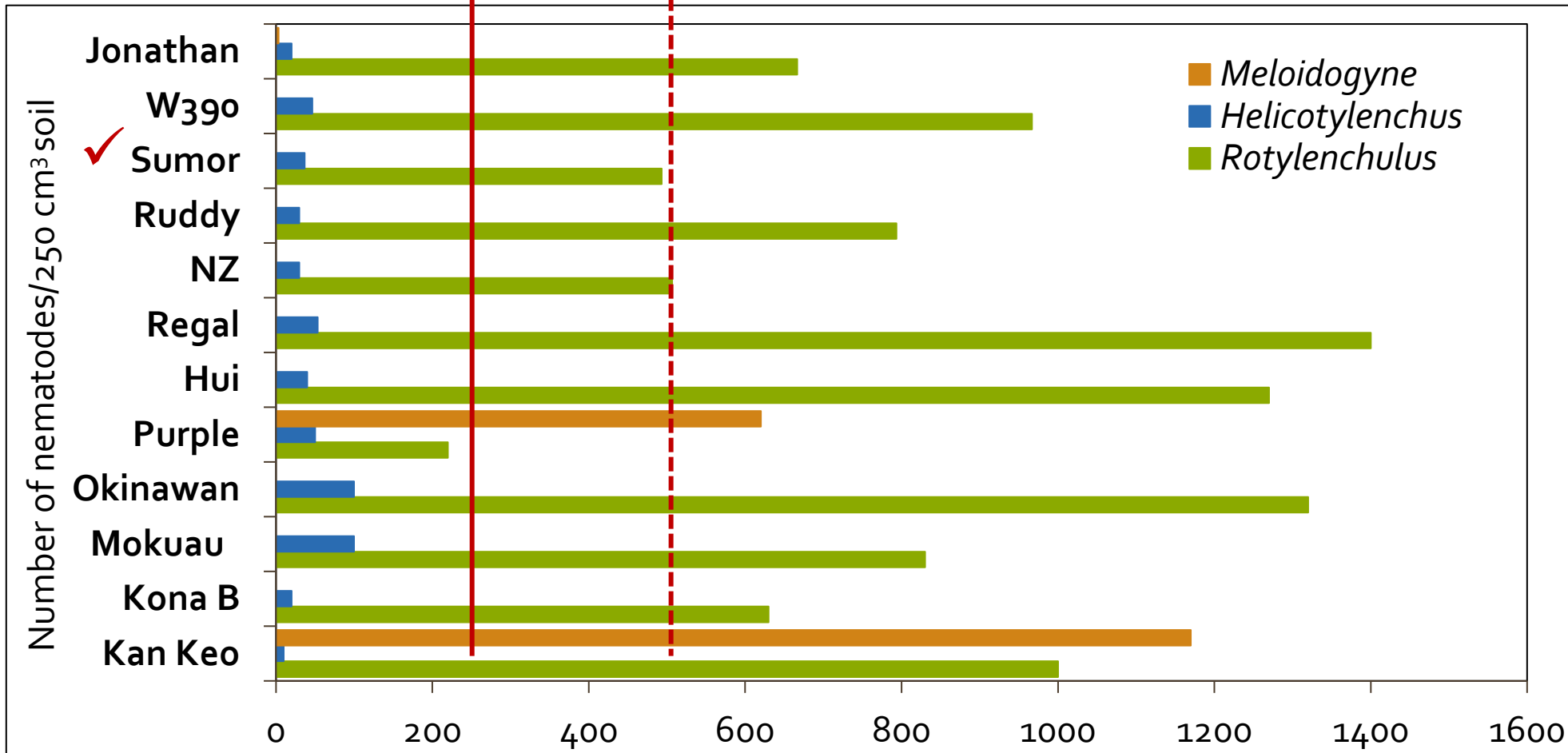
Spiral



Threshold root-knot @100/100 cm³ soil, reniform = 200 /100 cm³ soil at planting.

Preliminary screening of sweet potato varieties against reniform nematodes

At sweet potato harvest (4 months after planting)



Reniform



Spiral

Threshold root-knot @100/100 cm³ soil, reniform = 200 /100 cm³ soil at planting.

Three promising sweet potato varieties for Kaua'i from a 2019 trial

Roshan Manandhar, James Keach, and Emilie Kirk

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Variety	Total Yield (lb/ac)	Commercial-Grade Yield (lb/ac), % of total in Parentheses	Nematode Damaged Tubers (%)	Weevil Damaged Tubers (%)	Tubers with Both Nematode and Weevil Damage (%)
Ruddy	13878	6734 (48.5)	11.7	16.8	1.9
W-390	16524	6120 (37.0)	23.8	7.1	1.5
✓ Regal	14406	3961 (27.2)	13.1	4.3	3.3
Sumor	12457	3507 (28.2)	17.2	20.6	2.9
✓ Jonathan	8419	3200 (38.0)	25.2	14.7	0.0
NZ 196	3861	1312 (34.0)	44.4	37.4	2.3
✓ Okinawan	5634	1203 (21.3)	0.0	9.1	0.0



Nematode damaged by root-knot nematodes

(2022 CTHAR Cooperative Extension V46)

(<https://qms.ctahr.hawaii.edu/gs/handler/getmedia.ashx?moid=71115&dt=3&q=12>)

Management options

- Allelopathic cover crops
- Crop rotation
- Resistant sweet potato varieties
- ✓ • Nematicides:
 - Pre-plant
 - Post-plant

Pre-plant Nematicides - Fumigants

Require pesticide license

Table 3. Labeled Nematicides for sweet potatoes in Louisiana. *Please read and follow all label directions.*

Nematode species	Nematicide	Rate per Acre	Timing and Method of Application
Reniform Root-knot	Telone II	*See manufacture's label for rates	Apply at least 12 inches deep, seven-10 days prior to planting
	Mocap 15G	20-26 lbs /acre 1.6 – 2.1 lbs / 1,000 row feet. See manufacturer's label for additional detail.	Apply in a 12-15-inch band (42 in. row spacing). Incorporate 2-4 inches. Application timing is two to three weeks prior to planting.
	Mocap EC	5.1-6.9 fl oz. /1000 row feet. See manufacture's label for additional detail.	Apply in a 12-15 inch band (42 in. row spacing). Incorporate 2-4 inches. Application timing is two to three weeks prior to planting.
	AgLogic 15G	10-20 lbs/acre	Apply in a 12inch band over open furrow or soil surface and cover immediately during bed formation. Plant transplants in center of treated zone.
	Vapam HL	*See manufacture's label for rates	Must be applied at least three weeks prior to planting.
	K-Pam HL	*See manufacture's label for rates	Must be applied at least three weeks prior to planting.

(Smith et al., 2017; LSU)

Management Options against Reniform Nematodes

Bare fallow could knock down the population number of reniform and kill off infected sweet potato, but sweet potato is a great volunteer crop/hard to kill.



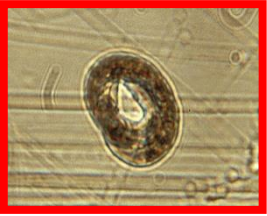
(Picture: Alton Arakaki)

Plant sunn hemp (SH) for 2 months (in soil pH > 5) with irrigation, till into ground (preferred 5 tons residues/acre) before planting sweet potato.

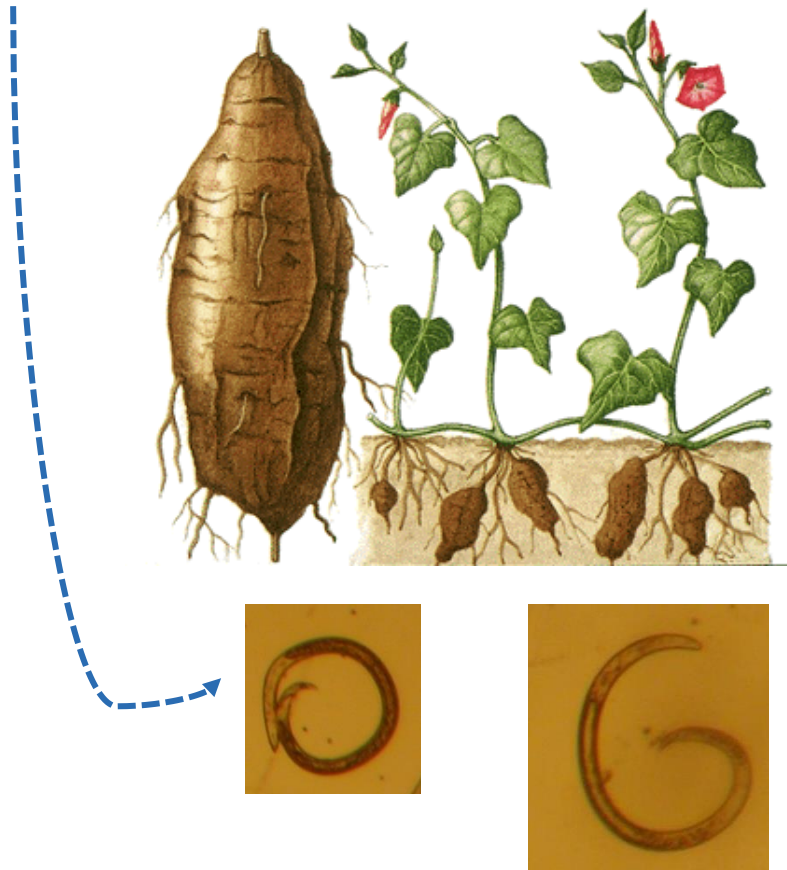


Crotalaria juncea

Produce allelopathic compound against plant-parasitic nematodes when incorporated into soil



Anhydrobiotic reniform nematodes are hardy, can survive drought condition, and revive after a susceptible host is planted

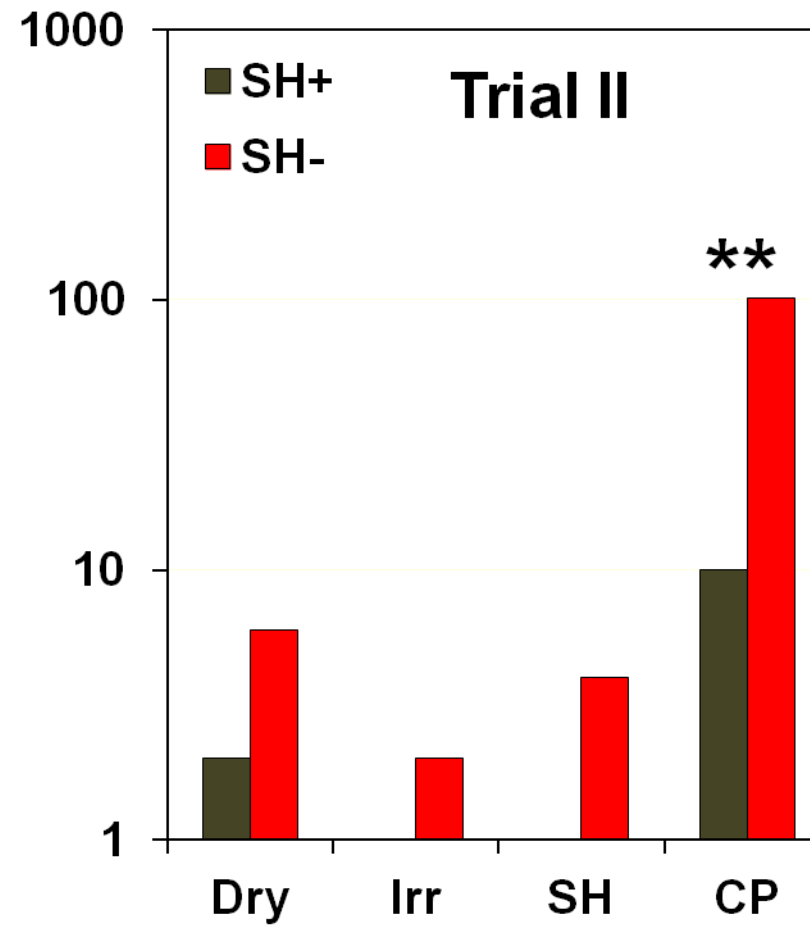
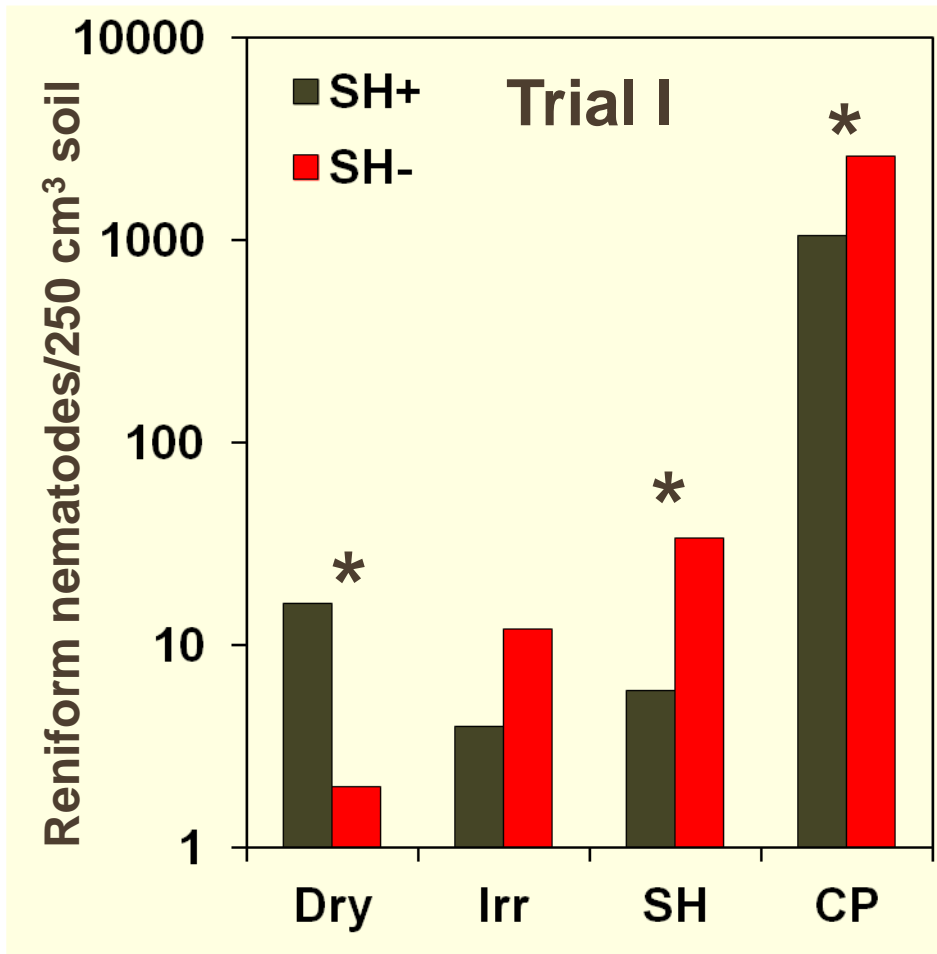


Vermiform stage

- Vermiform stage nematodes are known to be easier to kill than the survival stage.
- Sunn hemp is a poor host of reniform nematodes
- Can we stimulate reniform to turn into vermiform stage so that sunn hemp cover crop can kill reniform more efficiently?

Sunn hemp amendment suppressed reniform more effectively if previously planted with a host (cowpea or sunn hemp)

Reniform infested soil amended (SH+) or not amended (SH-) with SH at 1% (w/w)



Dry = no irrigation
 Irr = Irrigated
 SH = planted with sunn hemp
 CP = planted with cowpea

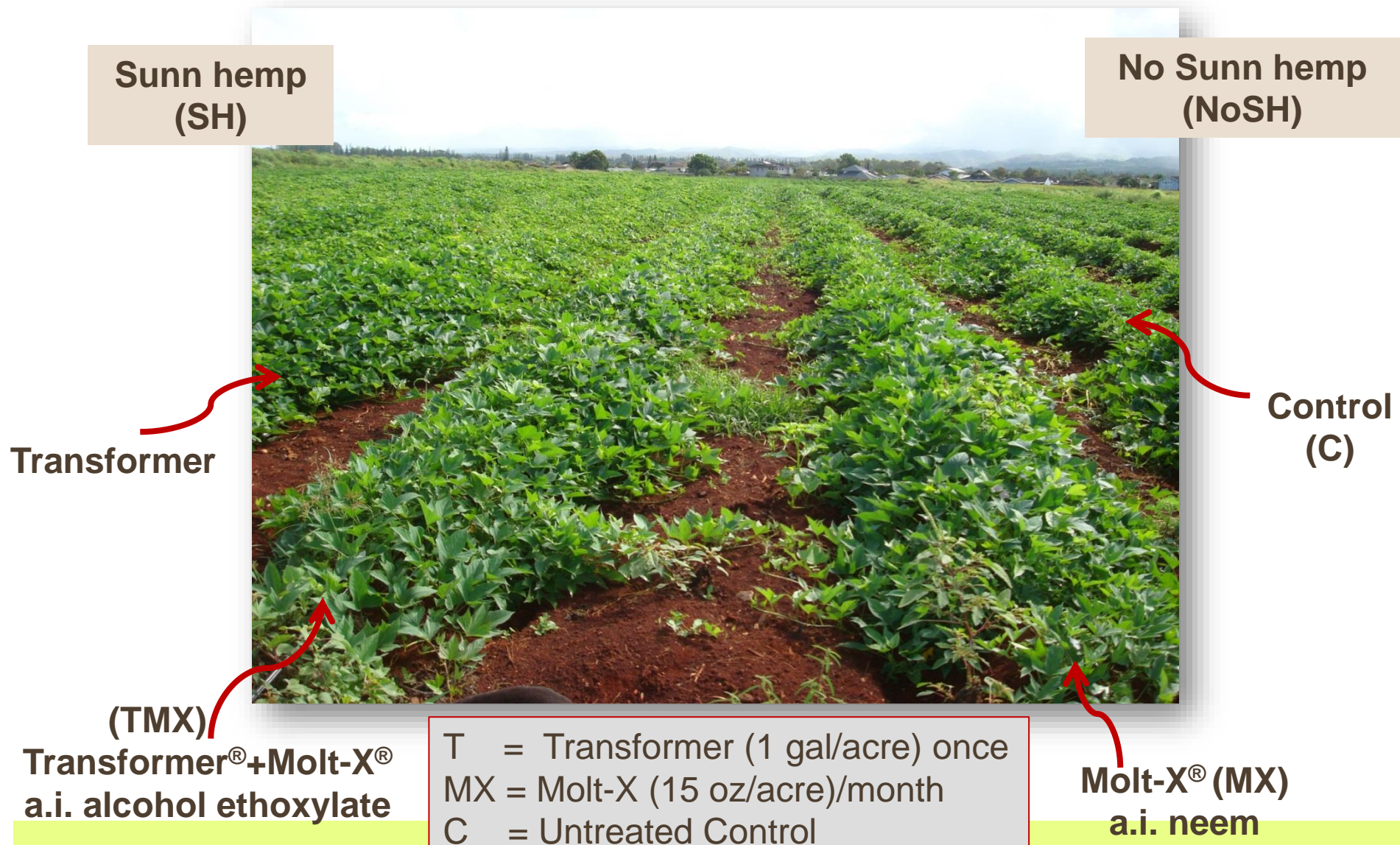
* = significant difference between SH+ and SH-

(Marahatta, Wang et al., 2012 Nematropica 42: 34-40)

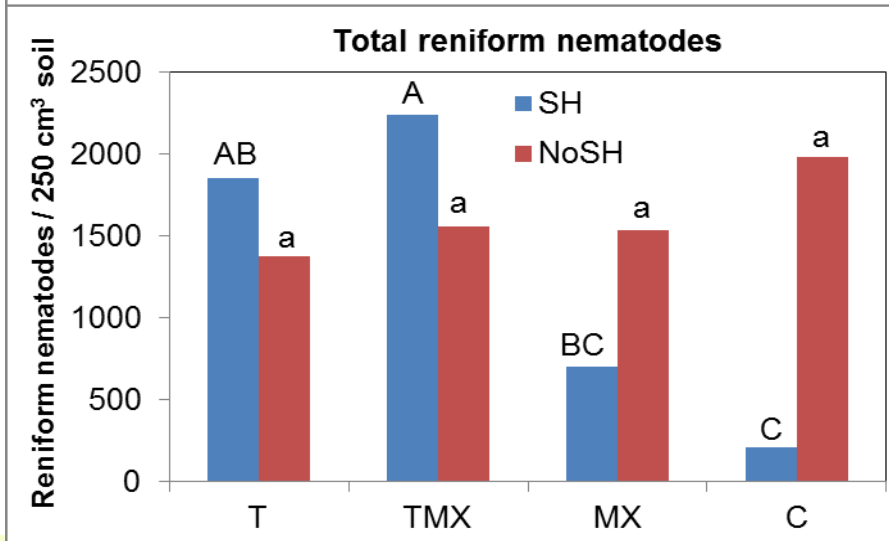
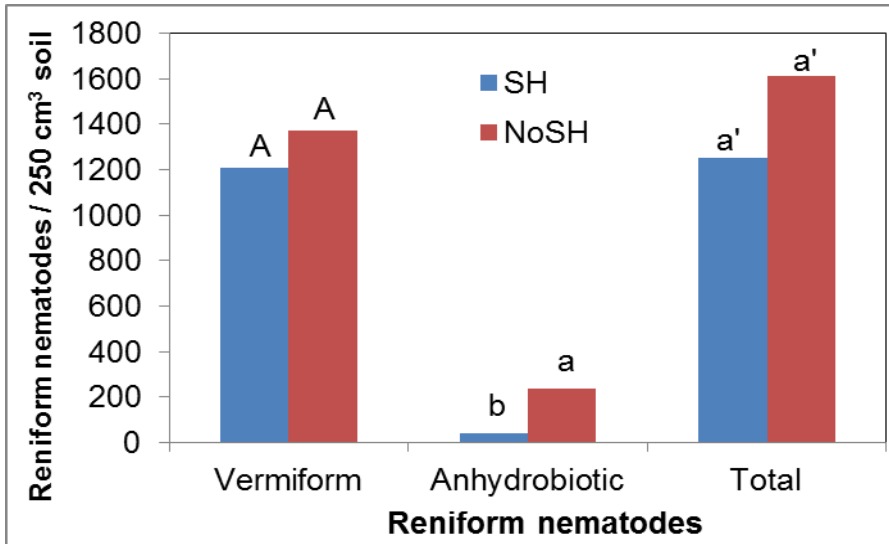
Integrating SH with Post-Plant Nematicide Injection



Integrating SH with Post-Plant Drenching



Integrating SH with Post-Plant Nematicide



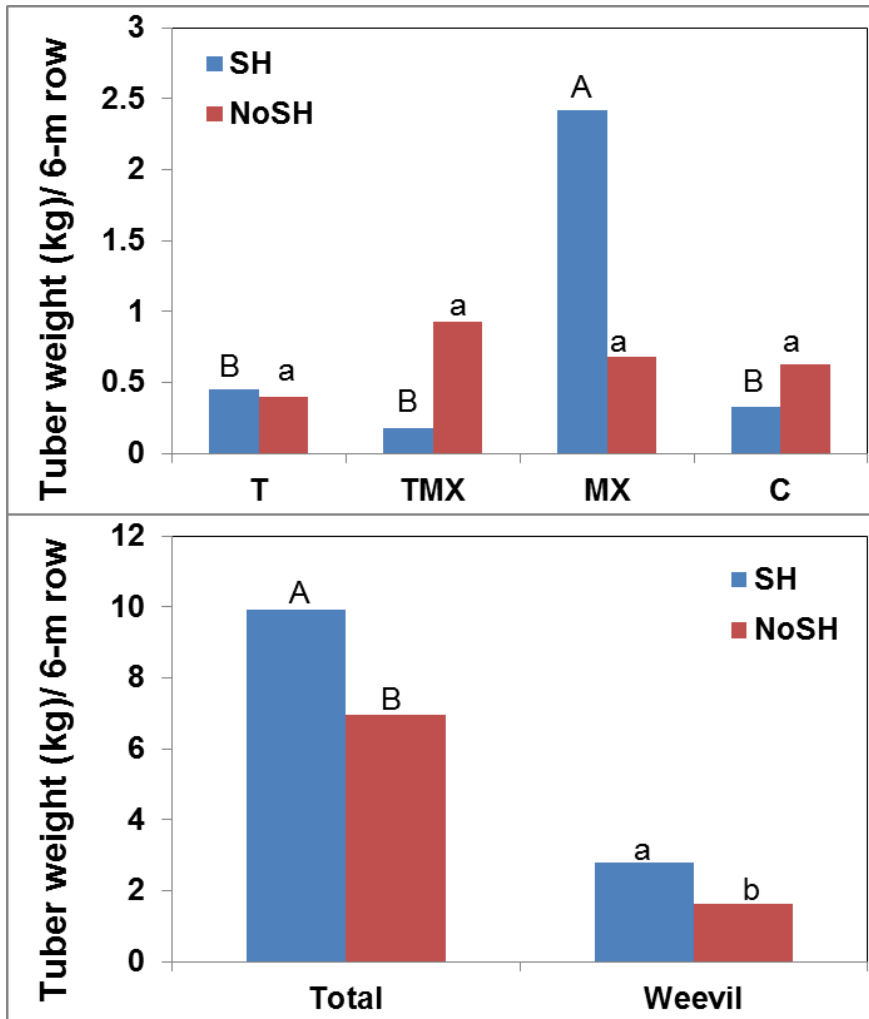
Molt-X[®] = a.i. azadirachtin (neem extract) OMRI listed

At 3.5 months after sweet potato planting (harvesting),

- Planting of SH only significantly reduced anhydrobiotic reniform nematodes.
- 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 Nematicide



- 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 organic nematicides, but can be costly (monthly treatment)

Materials and Methods

Control = untreated

Velum I = Velum[®] One @ 6.5 fl oz/a - 1 application through the drip irrigation at planting.



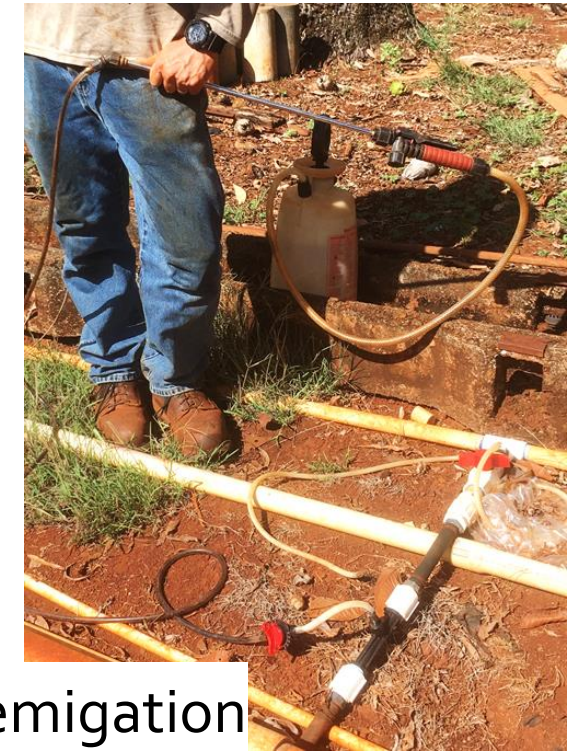
Velum II = Velum[®] One @ 6.5 fl oz/a - 2 application at planting and 2 wks after planting.



SH+Molt-[®] = sunn hemp incorporated at preplant and Molt-X (neem) treated 4 and 8 weeks after planting.



SH = Sunn hemp only



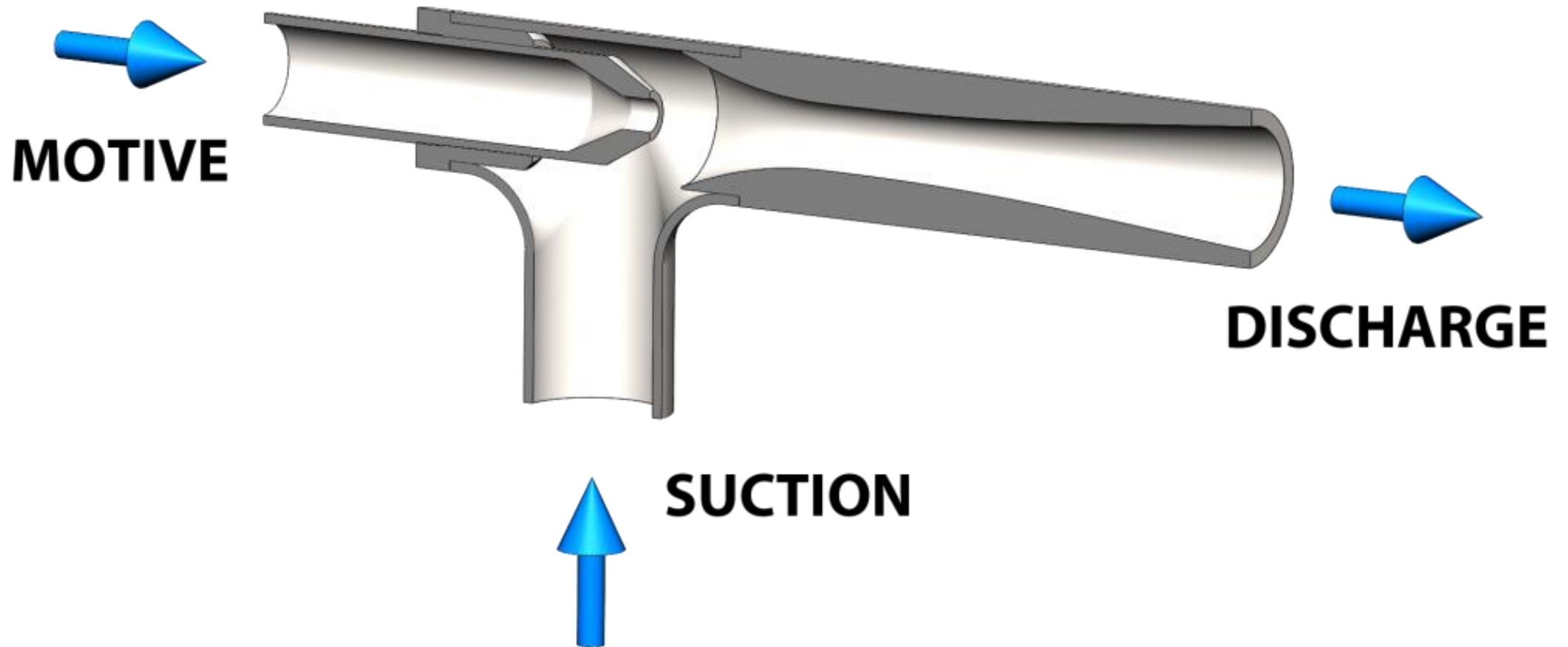
Chemigation

+



Nematicide applied through Chemigation

Venturi Siphon

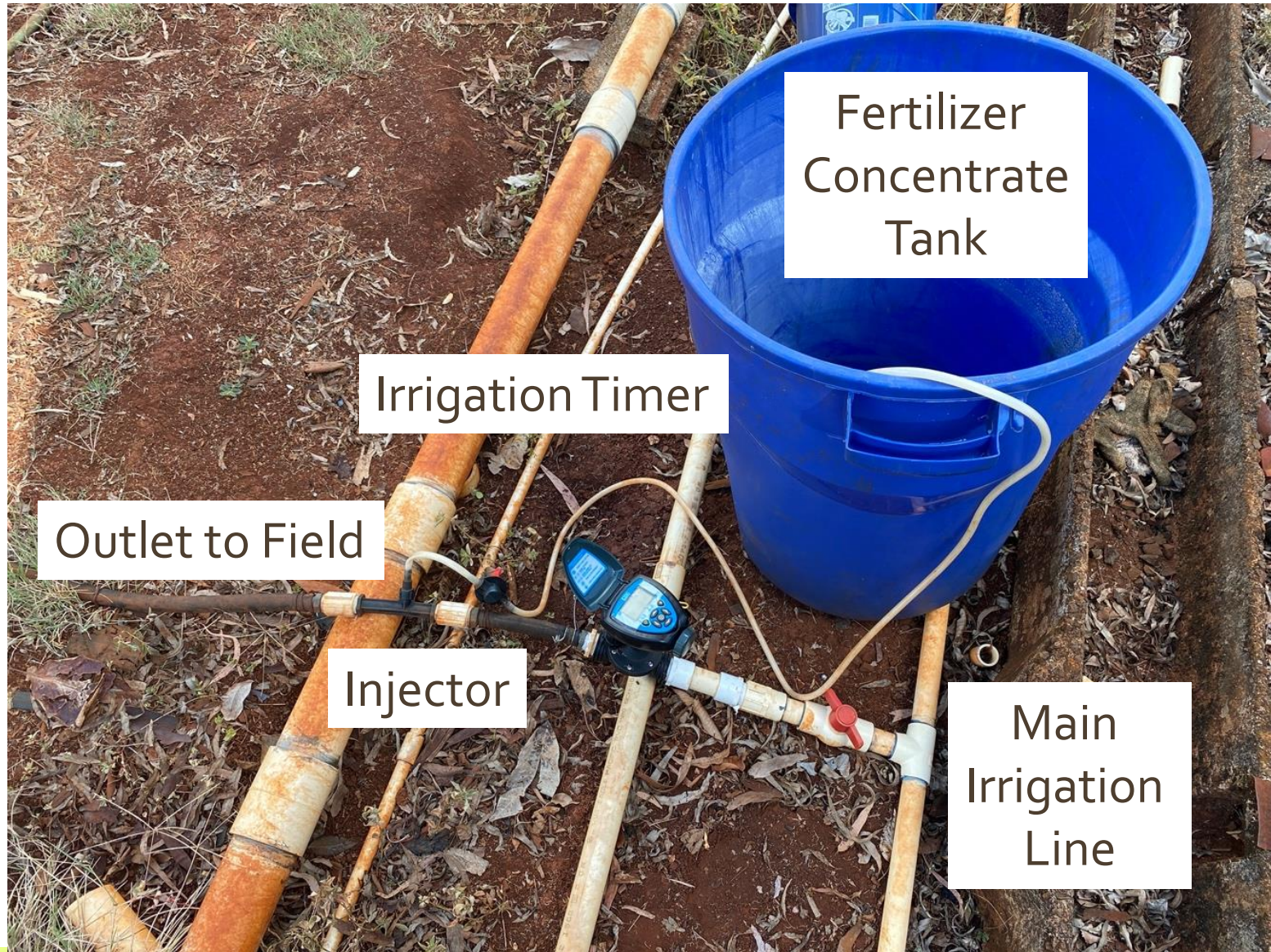


Venturi Siphon



https://www.amazon.com/DAWEIF-Irrigation-Fertilizer-Injectors-Agriculture/dp/Bo88R97FGS/ref=asc_df_Bo88R97FGS/?tag=hyprod-20&linkCode=df0&hvadid=459411117297&hvpos=&hvnetw=g&hvrnd=9505114819906667433&hvppone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9032799&hvtargid=pla-1135952514392&psc=1

Venturi Siphon Injector





Materials and Methods

Total of 7 trials conducted with variation in treatment time per Bayer request.



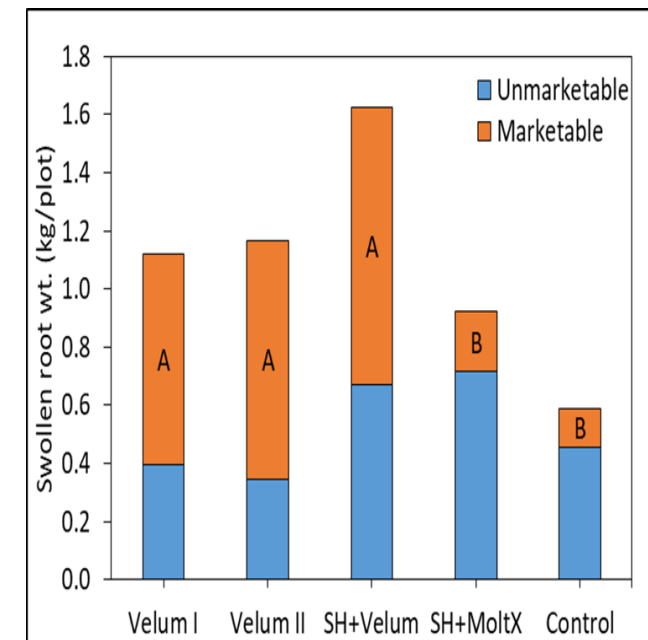
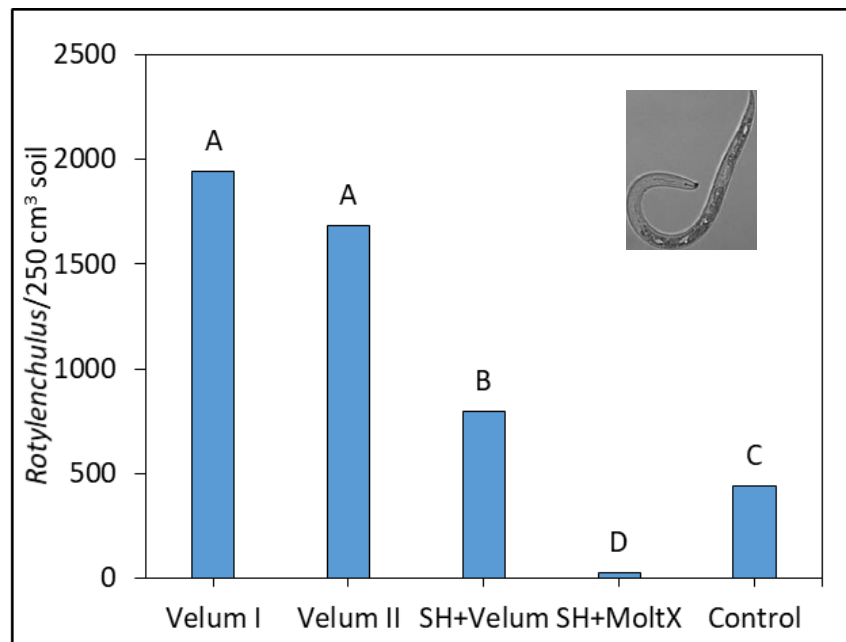
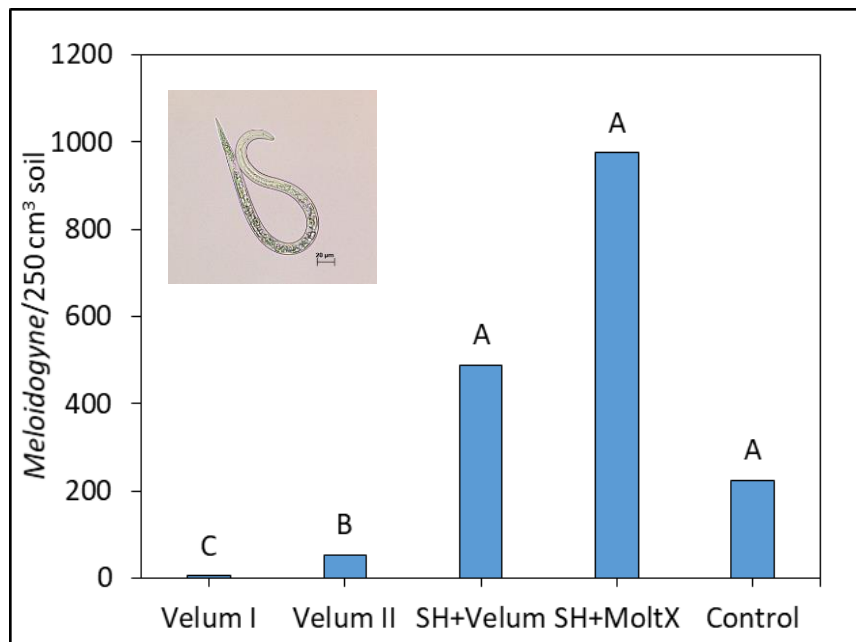
Chemigation

Crop	2017	2018	2019
	----- Velum	---Treatments---	----- --
Zucchini	o; o & 2 wk	o; o & 1 wk	o; 1 wk
Tomato	o; o & 2 wk	o; o & 1 wk	-
⇒ Sweet potato	-	-	o, 1 & 3 mon; o, 2 wk, 1 & 3 mon
Coffee	-	-	o & 1 mon

Molt-X[®] was treated once a month.

2019 Sweet potato

Velum is not registered for sweet potato in Hawaii yet but is registered for most vegetable crops.



Velum 0 = apply at planting;
 Velum 1 = apply 1 wk after planting;
 SH +Velum = Preplant of sunn hemp
 (SH)+Velum at 1 wk;
 SH+Molt-X = SH+ monthly injection of
 Molt-X
 Control = no treatment

Velum suppressed root-knot, Molt-X suppressed reniform nematodes.

Velum One is not registered for sweet potato.



- Root-knot affected sweet potato yield more than reniform nematodes.
- Sunn hemp added green manure effect, improved yield in SH+Velum.

Acknowledgement

- Poamoho Farm Crew
- Luis Aristizabal (Coffee farmer)
- CTAHR HAWo9034-R
- USDA ARS
 - Roxana Myers
 - Kathy Mello
- Donna Meyer, Peter Shroeder, Erzi Palko, Shelby Ching.



Any Questions?



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Sustainable Pest Management Lab
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