Improving Soil Health to Reduce Soil-borne Disease Pressure

Virtual Soil Health and Sustainable IPM

Mini Conference

Philip Waisen*, Koon-Hui Wang*, Sabina Budhathoki, Roshan Paudel, Amjad Ahmad, Joshua Silva, Jensen Uyeda

COOPERATIVE EXTENSION
UNIVERSITY OF HAWAI'I AT MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

Root-knot nematode

Panama wilt

Fusarium wilt

Rhizoctonia bottom rot

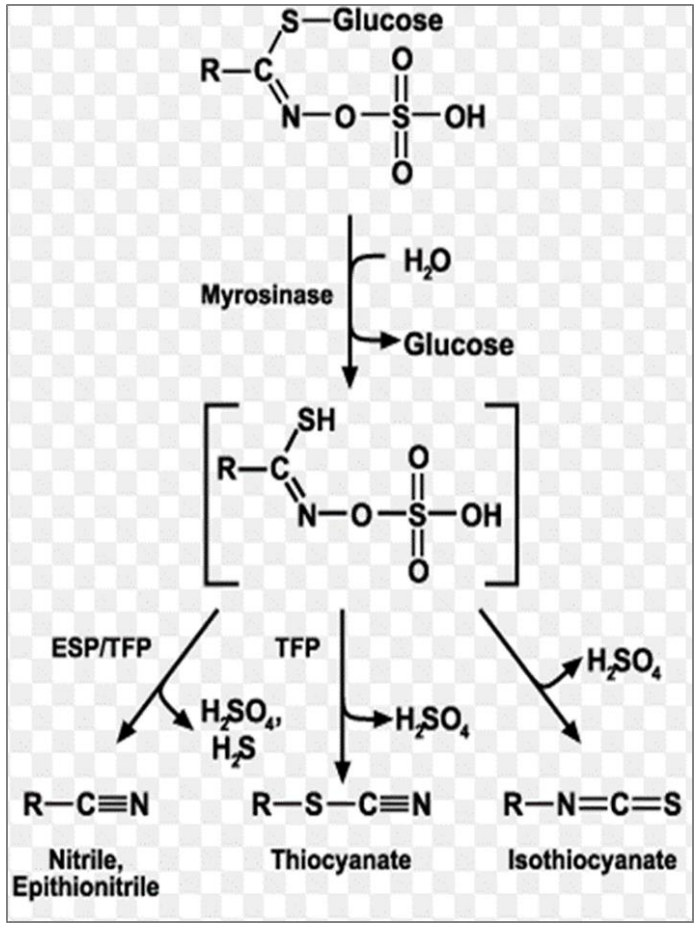
Asparagus crown and root rot

Targeted Soil-Born Diseases

- Asparagus Crown and Root Rot
- Banana Fusarium Wilt (Panama Wilt)
- Lettuce Fusarium Wilt/ Rhizoctonia bottom rot
- Zucchini nematodes

Biofumigation

The use of glucosinolate (GL)-derived isothiocyanate (ITC) from brassica cover crops to suppress soil-borne pests and pathogens (Kirkegaard et al., 1993)

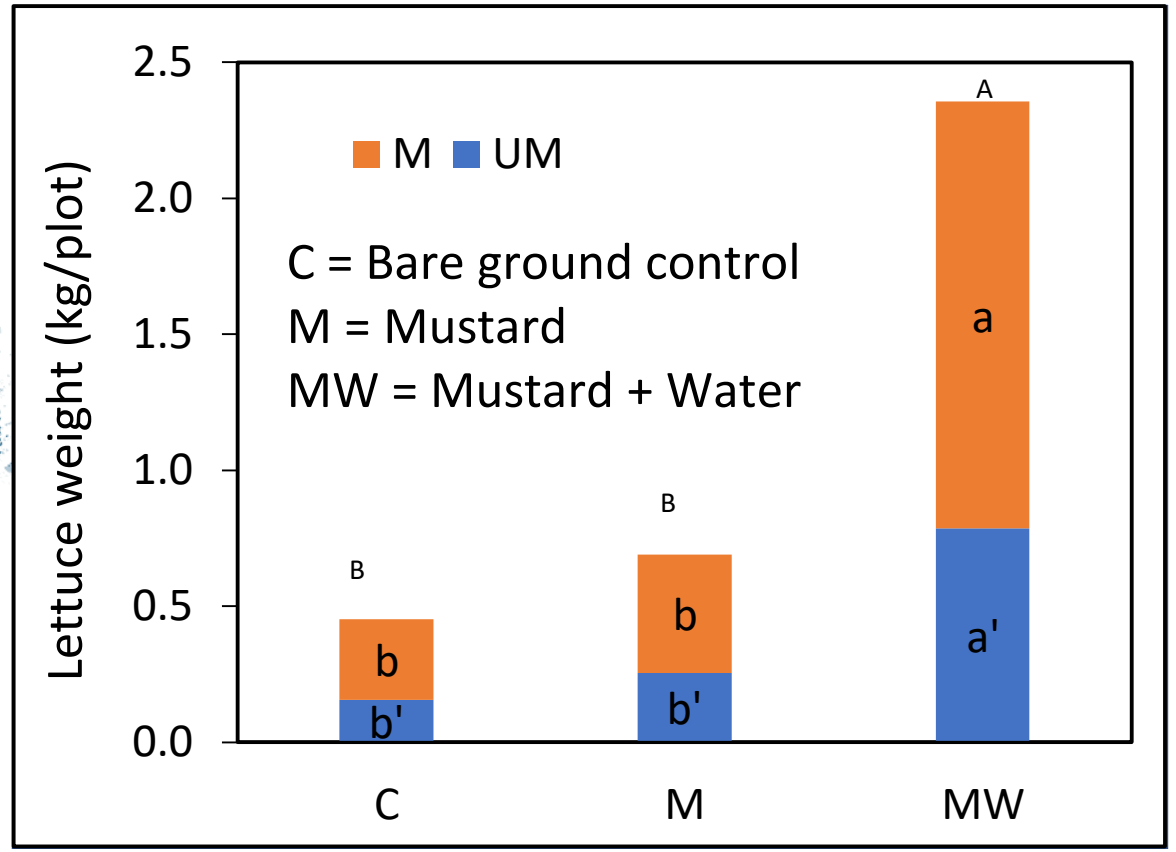


Lettuce Fusarium Wilt/ Rhizoctonia Bottom Rot

'Caliente 199' brown mustard
1.3 tons/acre

- Biofumigation using macerated brown mustard tissues to soil incorporated added with water to reach ~40% soil moisture and tarp with **solarization mulch** for 1 week prior to lettuce planting increased lettuce yield by **5 folds** compared to the untreated control.

Solarization mulch



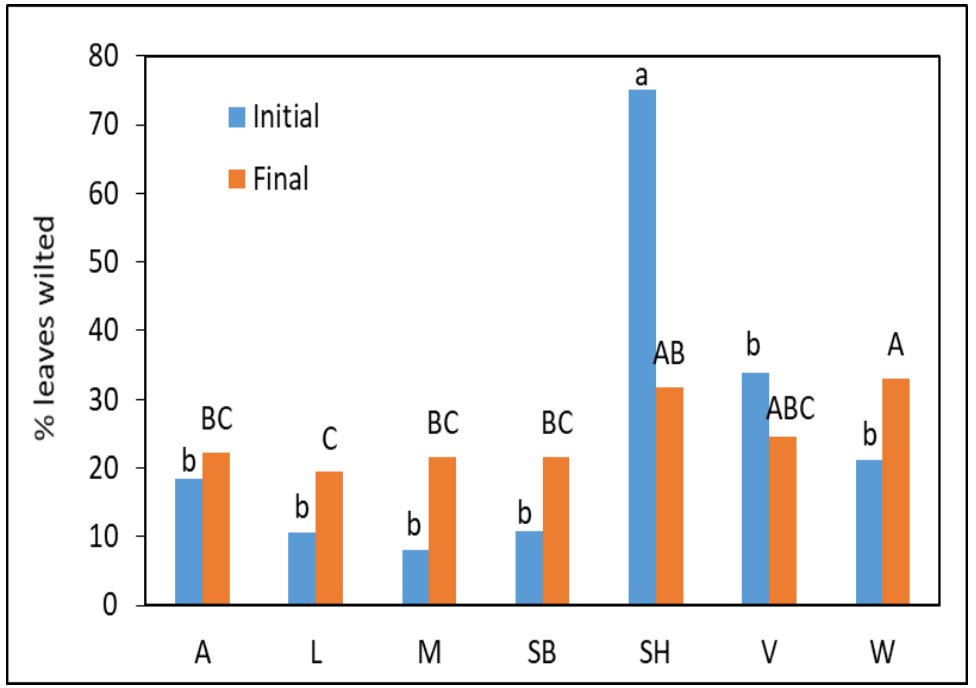
Biofumigation for Lettuce is profitable for small-scale production provides an alternative to fumigation on infested soil

Materials	Dry Amendment (lb)/acre	Price ($)	Seed (lb)/acre of amendment	Cost ($)/acre	Source
Brown mustard	4453.5	6.1/lb seed	16.63	101.44	Siegers Seed Company
Solarization mulch	-	0.0171/ft^2	-	744.88	Hardware World (include shipping cost)
Total cost				846.32	

- Commercial Manoa lettuce yields: **15,692 lb/acre**.
- Farm gate value (NASS, 2020) of head lettuce in HI is only **$2.03/lb** or **$32,403/acre**.
- Biofumigation can be profitable for Manoa lettuce to be conducted regularly.
- Once introduced into a field, *Fusarium oxysporum* f. sp. *lactucae* will probably remain indefinitely. This remains a viable option for farmers once in a while when needed.

‘Pisang Awak’ Banana Fusarium Wilt

- Soil drenching **lobster meal** (Crustacean meal) resulted in no recovery of *Foc* on Komada medium.
- Lobster meal also resulted in lower % of wilted leaves at 2 months after soil treatments.



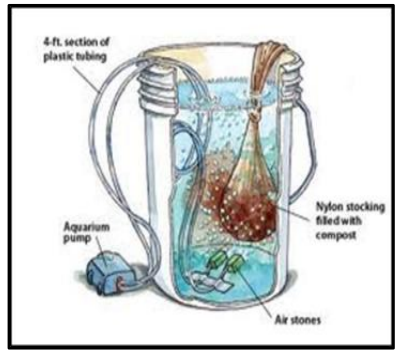
(A)
Streptomyces lydicus

(Sb)
Bacillus subtilis

(Sh)
Shrimp shell meal

(L)
Crustacean meal

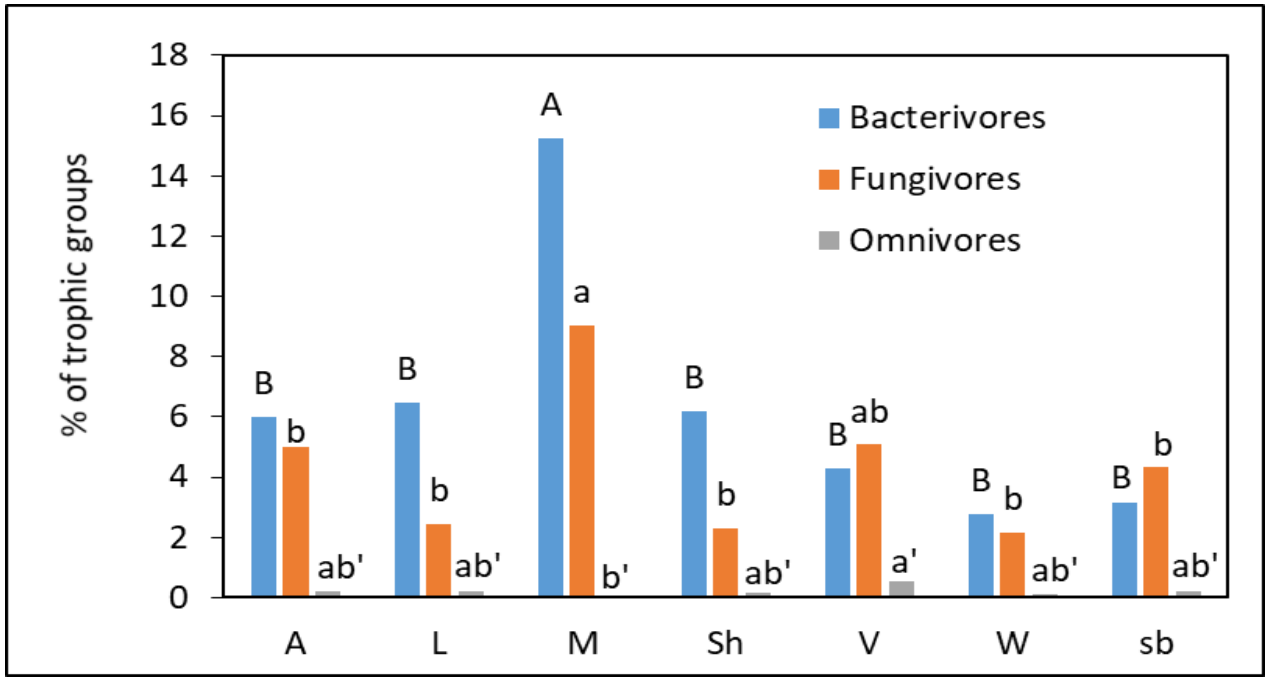
Macerated Brown mustard **(M)**



Vermicompost tea **(V)**

Water**(W)**

Banana Fusarium Wilt (*Fusarium oxysporum f. sp. cubense, Foc*)



Treatment	Rate		Unit cost ($)	$/acre
Actinovate AG	6.0	oz/acre	117/18 oz	3.34
Subtilex® NG	0.4	oz/acre	120/2 oz	2.06
Shrimp shell meal	35.0	lb/1000 ft^2	37.81/15 lb	329.40
Crustacean meal	35.0	lb/1000 ft^2	52/40 lb	169.88
Brown mustard	1.7	lb/plant	6.1/lb seed	16.07

- Biofumigation with brown mustard + soil drenching enhance bacterial and fungal decomposition at 2 months after treatment. Thus, improving soil nutrient cycling.
- At the standard banana yield of 22,000-30,000 lb/acre/yr and an elected price of $1.104/lb (~$24,288-$33,120/yr), combination of both crustacean meal and brown mustard amendment can still be affordable and worthwhile.

http://www.hawaiitropicalfruitgrowers.org/conferences/2019/2019_Crop_Insurance_for_Banana_Flyer.pdf

Asparagus Crown and Root Rot

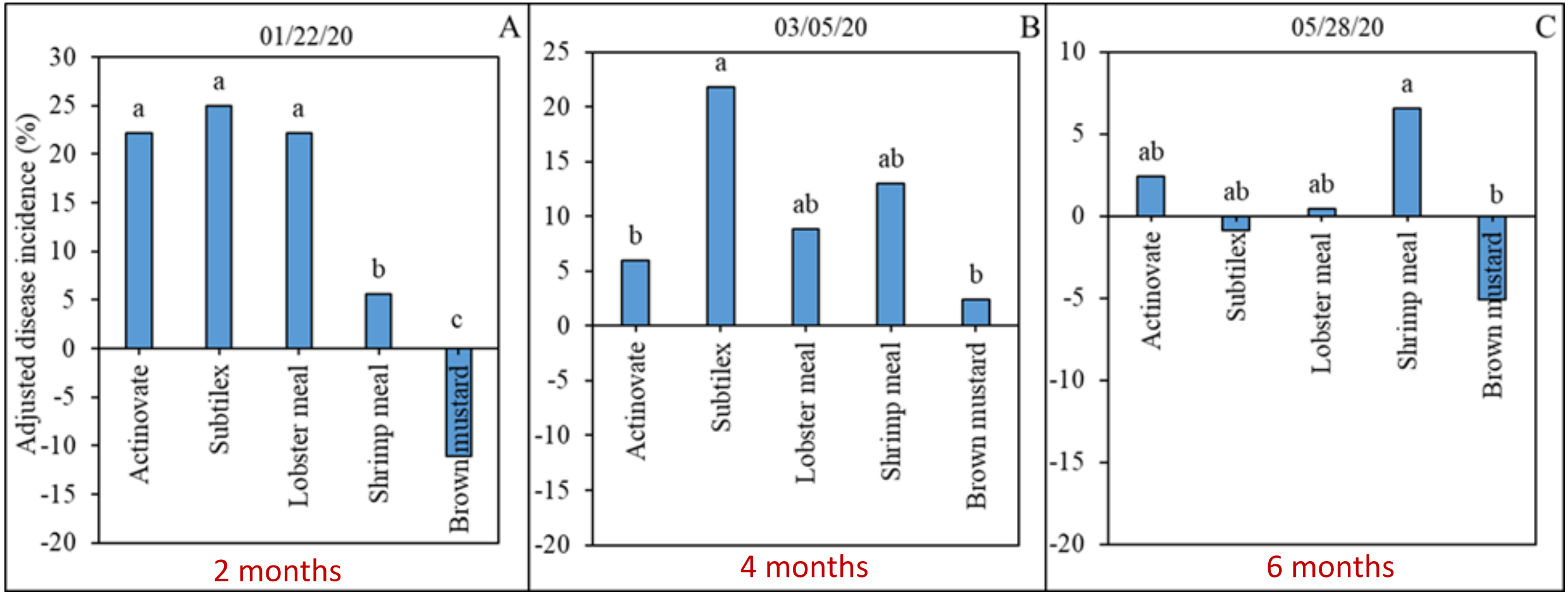
Weakened stems of asparagus chewed by burrowing cockroaches

Fusarium oxysporum f. sp. *asparagi* (*Foa*)

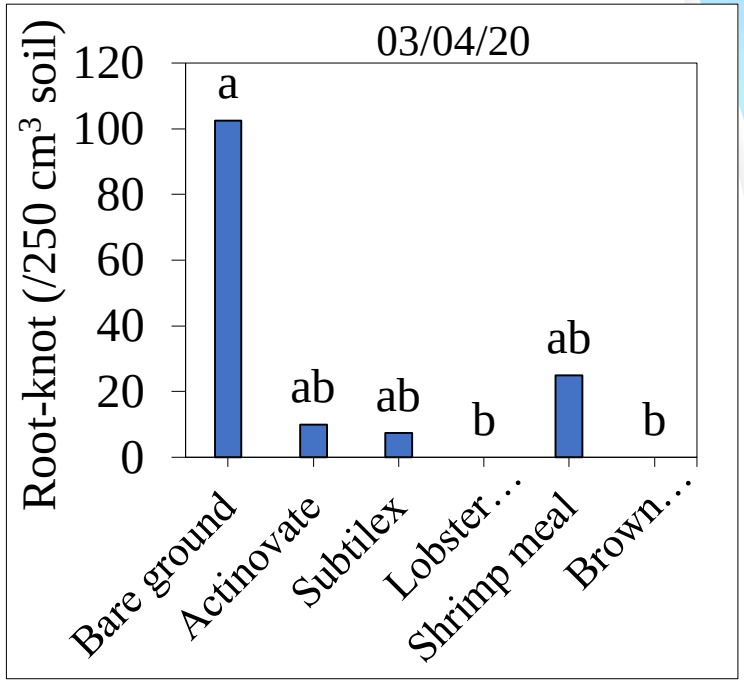
- Survives in the soil indefinitely, may be seed-borne, 50% yield loss.
- Besides rotting, can invade the xylem and plants will wilt following excessive harvesting.
- Interact with other diseases or insects add more stress to plants.
- 'UC 157', 'Apollo', and 'Jersey Giant' are high vigor var but not resistant.
- Keeping the soil pH>7 by liming could suppress this disease.
- Can maintaining healthy soil by biological soil amendments overcome *Foa* infestation?

Asparagus Preplant Soil Amendment

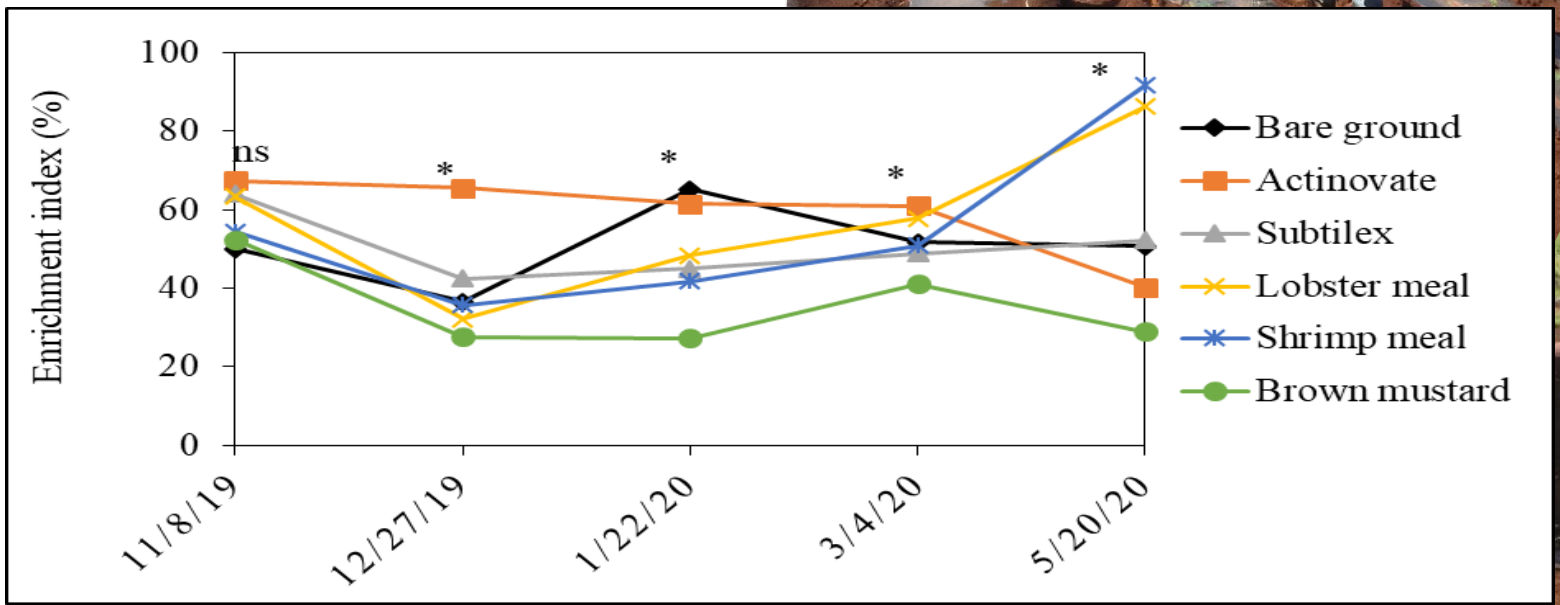
- Amending soil with macerated brown mustard (3200 lb/acre dry biomass)at pre-plant suppressed disease incidence of Foa over 6 months.



Asparagus Experiment



Post plant soil treatment with different biological soil amendment

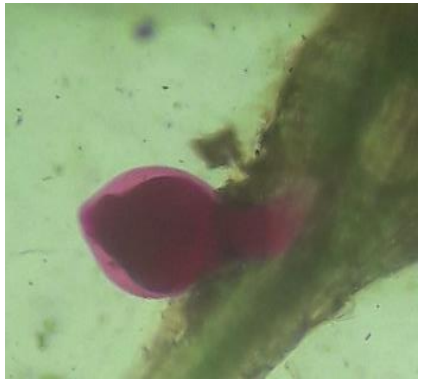


Product Cost Estimation

Asparagus is a high value crop. Combining crustacean meal and brown mustard might still be worthwhile. *Foa* can cause up to 50% yield loss in Hawaii.

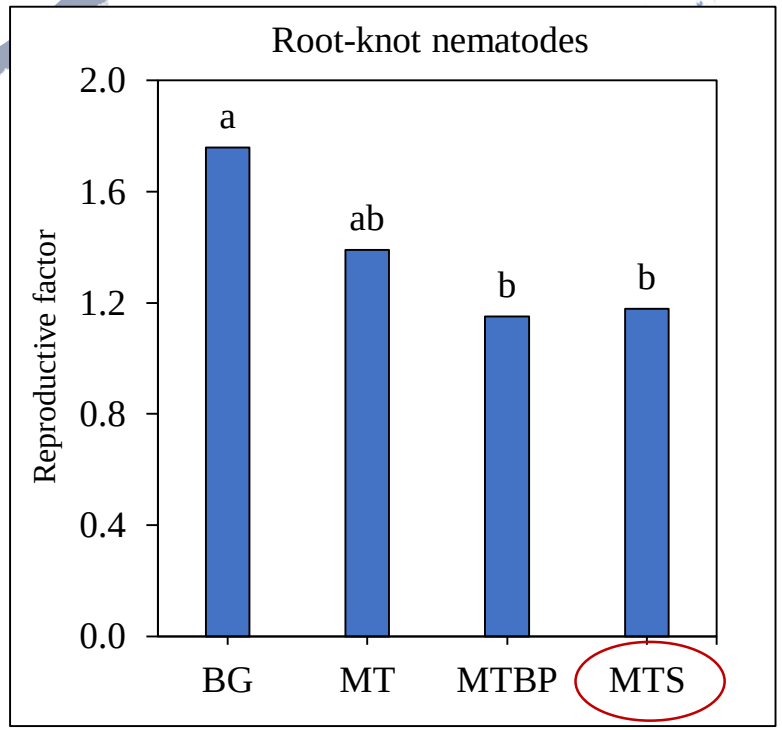
Treatment	Rate		Unit cost ($)	$/acre	Source
Actinovate AG	6.0	oz/acre	117/18 oz	6.50	Nutrient Solutions
Subtilex® NG	0.4	oz/acre	120/2 oz	4.00	Simplot
Shrimp shell meal	35.0	lb/1000 ft^2	37.81 /15 lb	640.50	Walmart
Crustacean meal	35.0	lb/1000 ft^2	52/40 lb	330.33	Nutrient Solutions
Brown mustard	1.2	lb/plant	6.1/lb seed	198.52	Siegers Seed Company

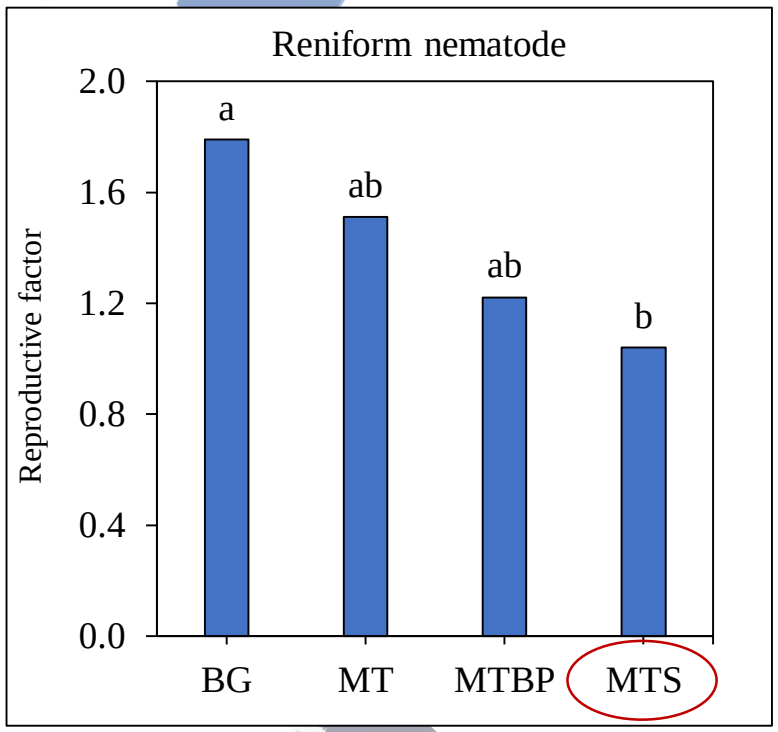
Zucchini Nematodes



Root-knot nematode

Reniform nematode





Biofumigation

- MT = Mustard till
- MTBP = Mustard till + black plastic
- MTS = Mustard till + Solarization
- BG = Bare ground

Biofumigation on Zucchini is Affordable and Profitable

Biofumigation	Plastic cost/row	Plastic/ft²	Plastic cost/ acre	Seed+ plastic cost/acre	Yield loss saved from nematode control	Source
Solarization[z]	$40.96	$0.0171	$743.42	$804	$11,021	Hardware World
Black Plastic[z]	$448.86	$0.0224	$977.62	$1,038	$14,327	Farm Plastic Supply

Biofumigation	Zucchini yield
Solarization	20%
Black plastic	26%
Ideal condition	33,600 lb/acre

Compared to BG

Take Home Message

- Brown mustard biofumigation + 40% soil moisture + Solarization can be a viable pre-plant treatment to remediate Fusarium and Rhizoctonia infested lettuce field.

- Crustacean meal + mustard as soil amendment suppressed Fusarium wilt on banana while improving soil nutrient cycling in a *Foc* infested banana orchard.

- Integration of brown mustard + black plastic tarp biofumigation and amending soil with lobster meal reduced asparagus crown and root rot, suppressed root-knot nematodes, and improved soil nutrient cycling.

- Brown mustard biofumigation + black plastic is affordable and profitable in root-knot nematode infested field. However, when the reniform nematode pressure is high, biofumigation + solarization is recommended.

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Cooperative Extension
University of Hawai'i at Mānoa
College of Tropical Agriculture and Human Resources

Sustainable Pest Management Lab
University of Hawai'i at Mānoa,
College of Tropical Agriculture and Human Resources