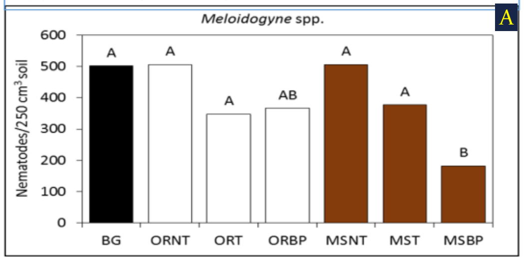
Oil Radish vs Brown Mustard

Brown mustard (tilled and covered with black plastic) produced more biofumigants against root-knot nematodes



Oil radish (tilled and covered with black plastic) is better for soil health improvement (more bacteria decomposition)

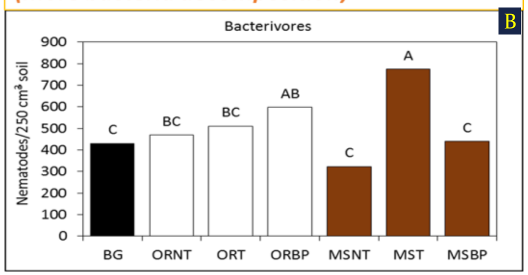


Fig. 5. Abundance of A) root-knot and B) bacterivorous nematodes affected by oil radish (OR) and mustard (MS) terminated by no-till (NT), macerated and tilled (T) or macerated, tilled and covered with black plastic (BP) for 1 week as compared to the bare ground (BG) control.

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Western SARE Sustainable Agriculture Research & Education

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Soil health-friendly Biofumigation

Ability of oil radish to improve soil health has previously been documented due to its abilities to scavenge nutrients, smother weeds, enhance antagonists of nematodes, alleviate soil compaction through bio-drilling and improve water infiltration while brown mustard releases potent ITC suppressive to plant-parasitic nematodes (Clark, 2008). In our study, following the biofumigation protocol described, brown mustard suppressed soil populations of root-nematodes more efficiently while oil radish increased abundance of bacterivorous nematodes than the BG control (Fig. 5).

Therefore, future research should look into examining Soil Health-friendly biofumigation approach using mixed cover cropping of mustard and oil radish.

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Trap Cropping and Biofumigation for Plant-parasitic Nematode Management

'Caliente 199' Brown mustard (*Brassica juncea*)

'Sodbuster' Oil radish (*Raphanus sativus*)

What is biofumigation?

Biofumigation is the use of brassica plant-derived chemicals to manage soil-borne pests and pathogens in agroecosystems. Plants in Brassicaceae family such as brown mustard, *Brassica juncea* and oil radish, *Raphanus sativus* contain glucosinolates (GLS) and myrosinase (Myr) enzyme. Upon maceration of tissue and disruption of the plant cell, Myr comes in contact with GLS and breaks it down into sulfate and isothiocyanates (ITC) among other volatile compounds (Fig. 1). Of these compounds, especially ITC, is toxic to soil-borne pathogens and pests including plant-parasitic nematodes. However, suppression of plant-parasitic nematodes using biofumigation has been inconsistent. Current research at the College of Tropical Agriculture and Human Resources is developing a step-by-step protocol to help farmers to perform biofumigation against nematode pests.

To enhance the nematode suppressive effects of biofumigation, researchers are integrating ***trap cropping*** approach to this ecological based nematode management strategy.

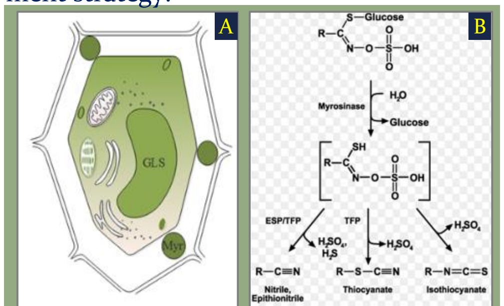

Fig 1. A) Intact plant cell of biofumigant crop showing distribution of glucosinolate (GLS) and myrosinase (Myr); B) GLS hydrolysis pathway to form isothiocyanate (ITC), sulfate and other products.

When to terminate the trap crop?

Conventional trap crop of plant-parasitic nematodes is a susceptible host that allow the infection of the nematodes, but if terminated prior to the nematode mass reproduction, it would trap the nematodes. When the trap crop is a biofumigant crop, the trapped nematodes would then be fumigated at crop termination and hence reduce the nematode pressure in the field. Therefore, time of termination of biofumigant crops for biofumigation is critical. Results from a field trial in Hawaii showed that terminating oil radish at 4 weeks after planting provided sufficient biomass (Fig. 2) to stimulate the subsequent pumpkin plant growth while reducing root-gall index on the crop (Fig. 3).

Fig. 2. 'Sodbuster' oil radish terminated at different time of growth.

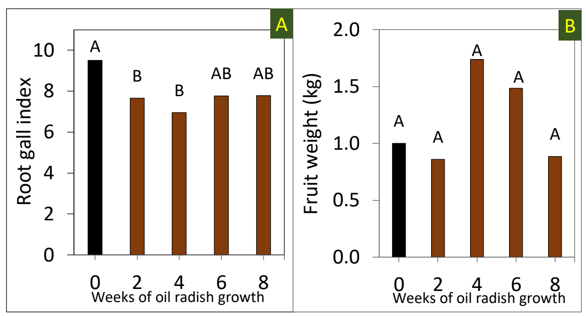

Fig. 3. Effect of oil radish growing time on A) pumpkin root gall index (1-10 scale) caused by root-knot nematodes, and B) pumpkin fruit weight per plot.

Terminate biofumigant crops

A step-by-step method to conduct biofumigation for best nematode management practice is developed based on the understanding that oil radish and brown mustard are hosts of root-knot nematodes, tissue maceration is required for GLC to be converted to ITC, and ITC is volatile.

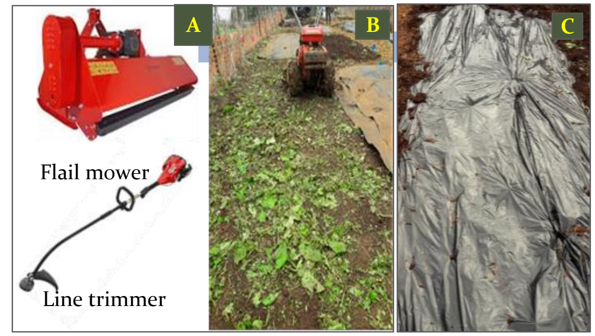

Fig. 4. A) Flail mower and line trimmer; B) hand-held rototiller incorporating macerated tissues into soil; C) cover the soil with black plastic mulch.

Step-by-step protocol for effective biofumigation against plant-parasitic nematodes:

1. Grow brown mustard or oil radish as cover crop at a seeding rate of 10 lb/acre (11 kg/ha) for 4-5 weeks (trap cropping is served at this time), producing dry biomass equivalent to 0.5-1.5 t/acre (1.2-3.7 t/ha).
2. Macerate tissues using line trimmer or flail mower to enhance conversion of glucosinolates to isothiocyanates (Fig. 4A).
3. Incorporate macerated tissues using roto-tiller to 4-6 inches (10-15 cm) soil depth (shallow till minimize soil disturbance).
4. Cover black plastic mulch to contain isothiocyanates from escaping into the air.
5. Uncover the plastic mulch 7 days after tarping then transplant cash crop seedlings immediately (avoid direct seeding of small seeded crops).