

MANAGING PLANT-PARASITIC NEMATODES USING TRAP CROPPING AND BIOFUMIGATION

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Plant-parasitic Nematodes

- > 4,100 species of plant-parasitic nematodes are known
- \$100 billion/yr loss worldwide
- \$10 billion/yr loss in USA
- Root-knot nematodes can cause 20-38% crop loss
- Especially damaging to cucurbit crop (no resistant cultivars)
- Cover crops provide great potential to suppress plant-parasitic nematodes.



Sunn hemp
Crotalaria juncea
-- monocrotaline



French Marigold
Tagetes patula
-- α -terthinyI

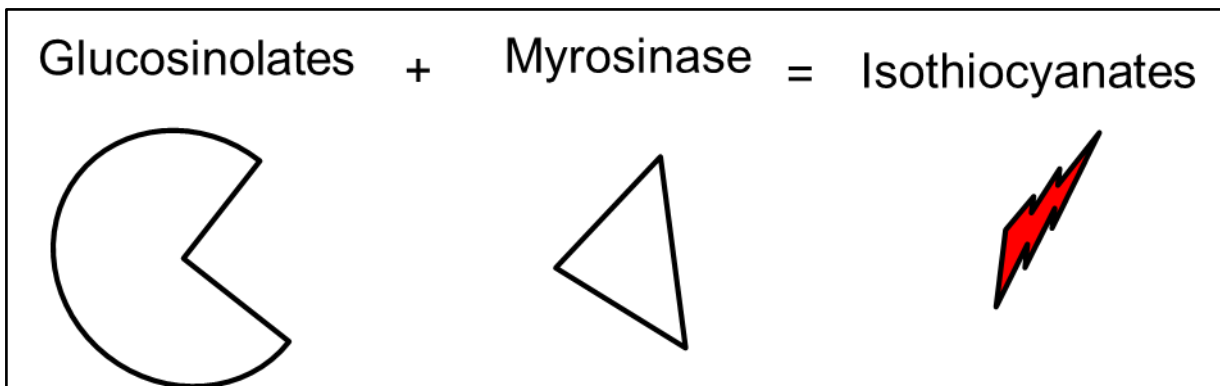


Sorghum-sudangrass
-- Dhurrin



Radish and mustard
✓ -- glucosinolate

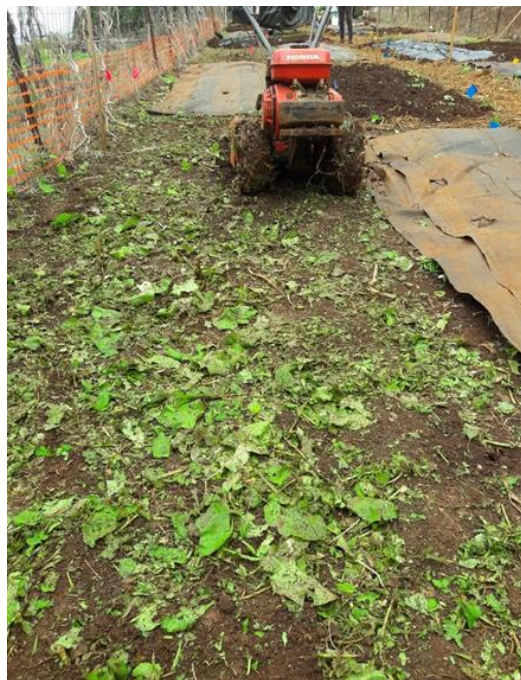
Oil Radish and Mustard as Biofumigants



Cover with black plastic



Glucosinolates



Isothiocyanates



More isothiocyanates

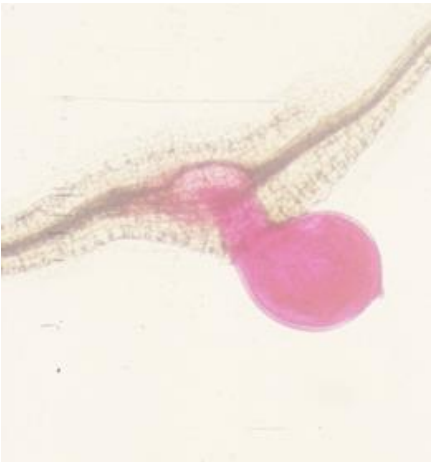
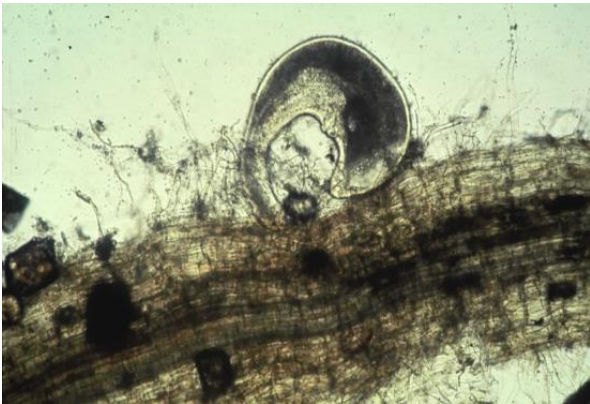


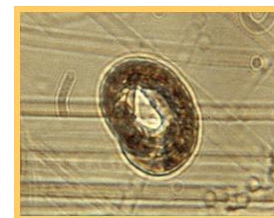
Trap isothiocyanates

Oil radish and Mustard as Trap Crops

Trap crop



	Root-knot nematode	Reniform nematode	Trap cropping effect
			
Oil radish	Poor host	Poor host	Slightly
Mustard	Excellent host	Non-host	Good for root-knot



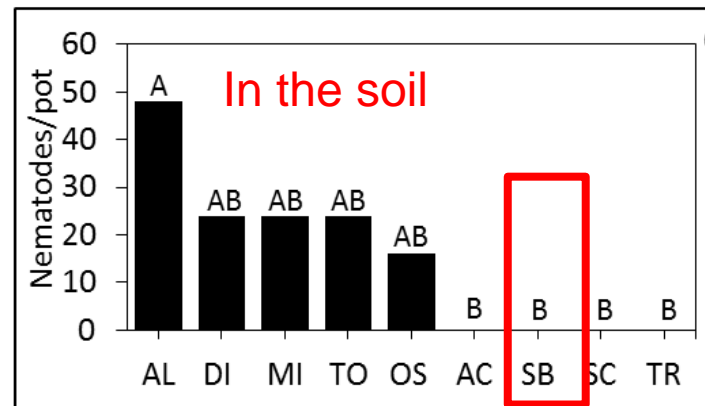
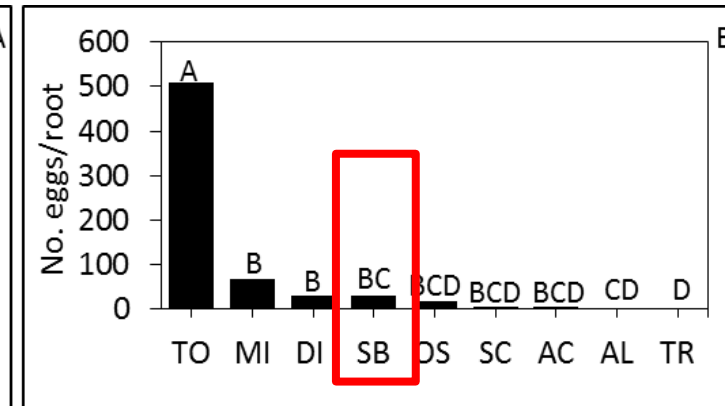
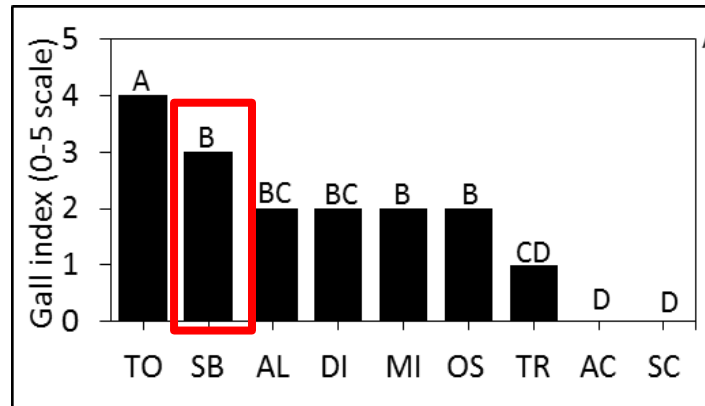
Anhydrobiotic

Objectives

- To screen oil radish and mustard cultivars for trap cropping and biofumigation effects against root-knot and reniform nematodes.
- To determine best termination time of oil radish in a field trial.
- To determine best cultural practices for biofumigation effects.

1.1 Susceptibility of radish cultivars to *M. javanica*

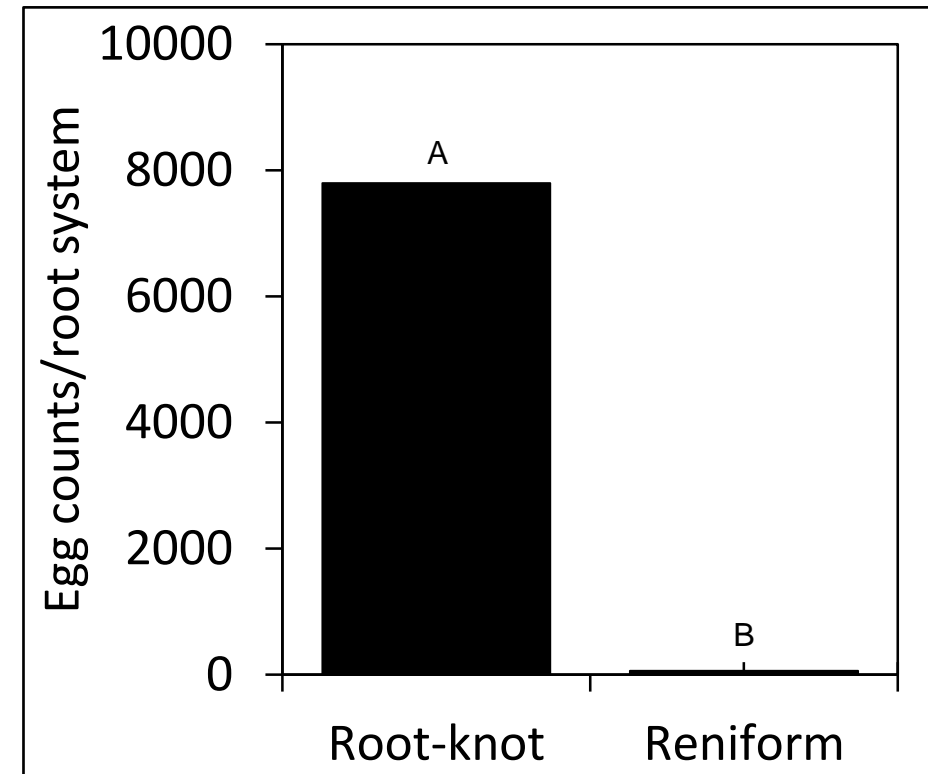
Radish cvs	Price
Alpine	\$98.22/lb
April Cross	\$112/ 10 million seeds
Discovery	N/A
Miyashige	\$76.50/lb
Oshine	\$169.95/lb
Sodbuster	\$2.25/lb
Summer Cross	\$147.90/lb
Tillage Radish	\$3.72/lb



8 oil radish cvs + 'Orange Pixie' tomato inoculated with root-knot nematodes, examine for 1 month.

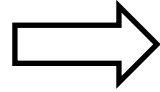
A) Radish gall index; B) Nematodes/250 cm³ soil; C) Nematodes/4-L pot

Susceptibility of 'Caliente 199' mustard to root-knot and reniform nematodes



'Caliente 199' mustard is an excellent host for root-knot nematode (*M. javanica*) whereas it is a poor host for reniform nematode ($Pi=1000$ IJ2s)

Biofumigation Effect



Nematode infested soil was amended with 1% (w/w) residues of 8 oil radish cvs. and compared to unamended control, 'Orange Pixie' tomato was used as bioassay crop.

Starting nematode populations

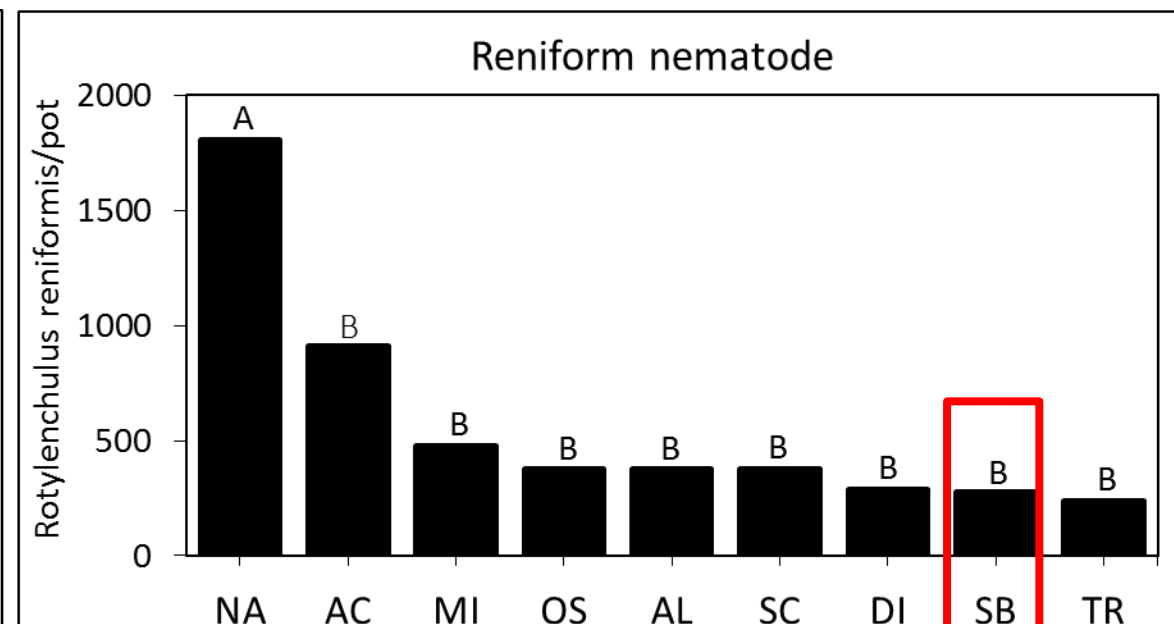
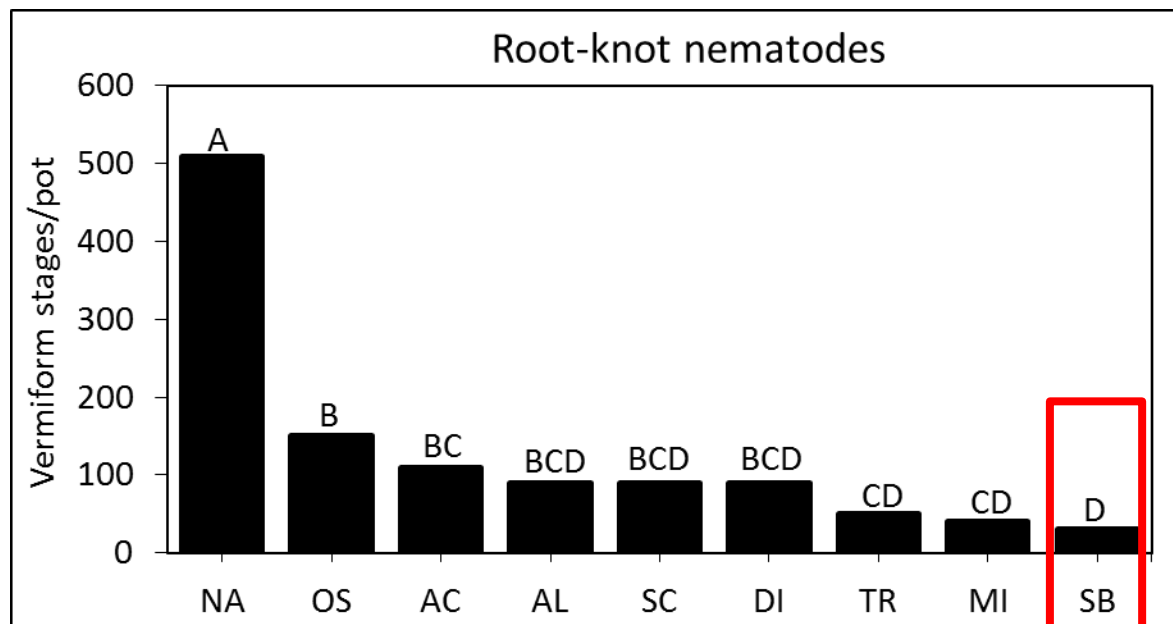
Root-knot = 2130

Reniform = 2270



Plant growth difference on tomato 'Orange Pixie'

Biofumigation Effect of Oil Radish to root-knot and reniform nematodes



NA = no amendment; AC = April Cross; AL = Alpine; MI = Miyashige; OS = Oshin; SB = Sodbuster; SC = Summer Cross; TR = Tillage Radish

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Field Trial

Growing period of Oil Radish as a
Cover Crop

8 weeks

6 weeks

4 weeks

2 weeks

0 week

Termination of oil radish



2 weeks



6 weeks



4 weeks



8 weeks



Oil radish was planted for different length of time (0, 2, 4, 6 and 8 weeks). Experiment was arranged in RCBD with 4 replications. Pumpkin was planted after oil radish (OR) termination and incorporation, nematodes were sampled at OR termination and at 4 weeks after pumpkin planting.

Severity of pumpkin root galls by root-knot nematodes

Root Gall Index based on 0 – 12 scale

RGI = 0



RGI = 6



RGI = 9



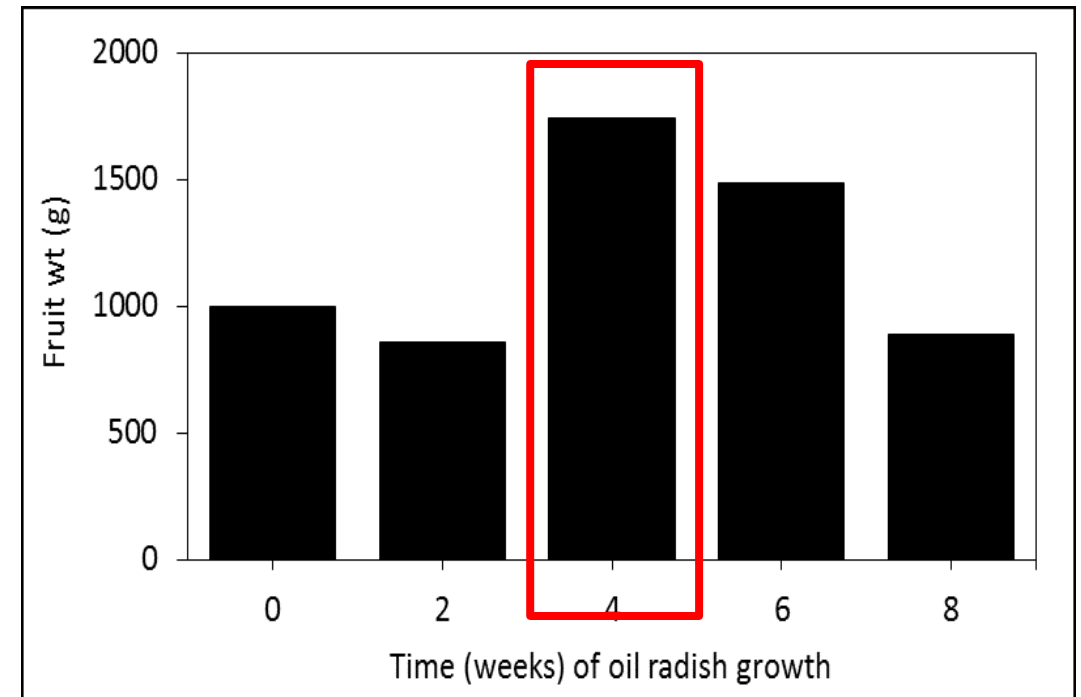
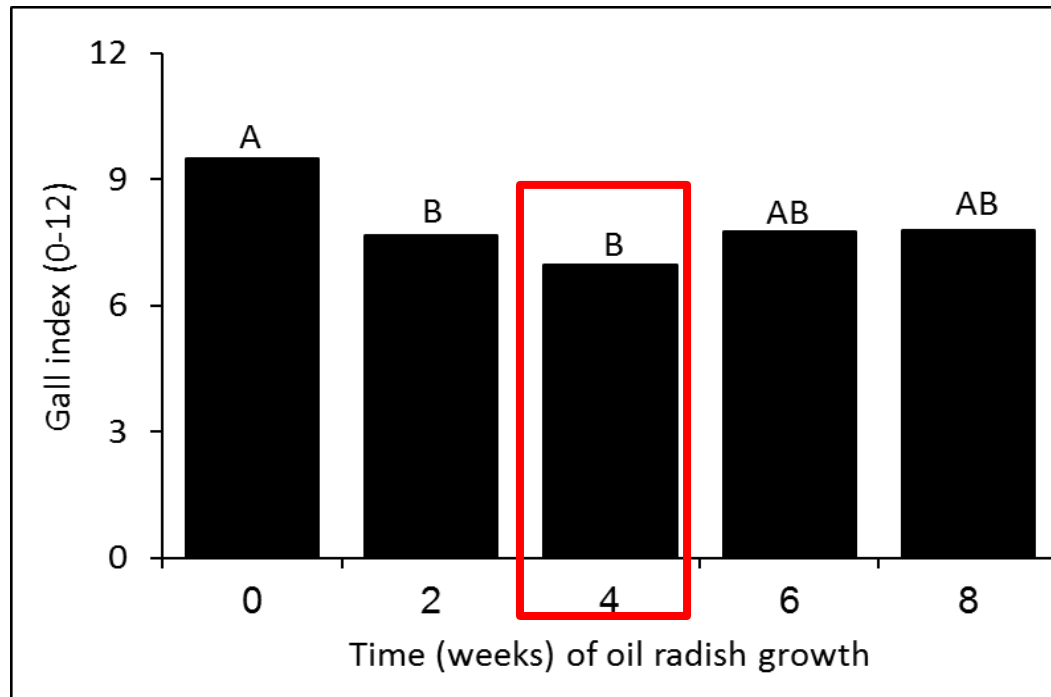
RGI = 12



Oil radish did not suppress PPN in the soil but reduce root galls on pumpkin

Repeated measure over 3 sampling dates at monthly interval

Herbivores	Nematodes/250 cm ³ soil				
	0	2	4	6	8
Root-knot nematode	178 A	140 A	213 A	160 A	467 A
Reniform nematode	371 A	256 A	874 A	168 A	312 A
Stubby root nematode	36 A	20 A	32 A	22 A	33 A

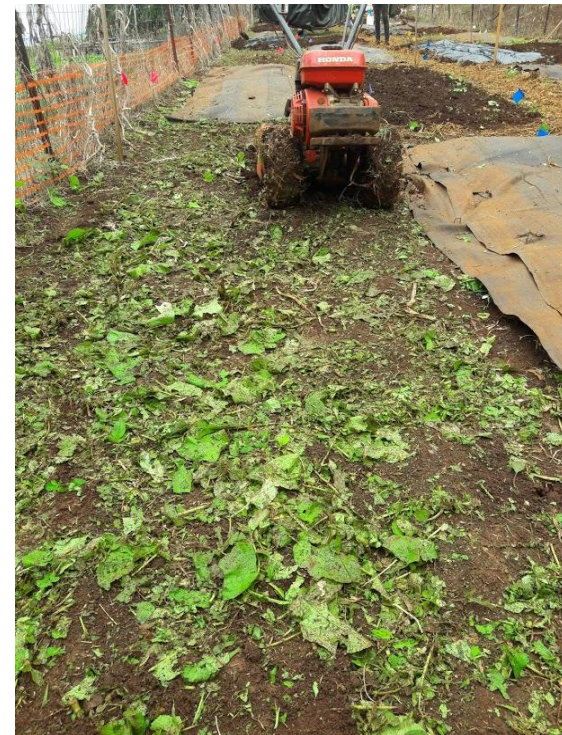


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Materials and methods

Cover crop termination and biofumigation



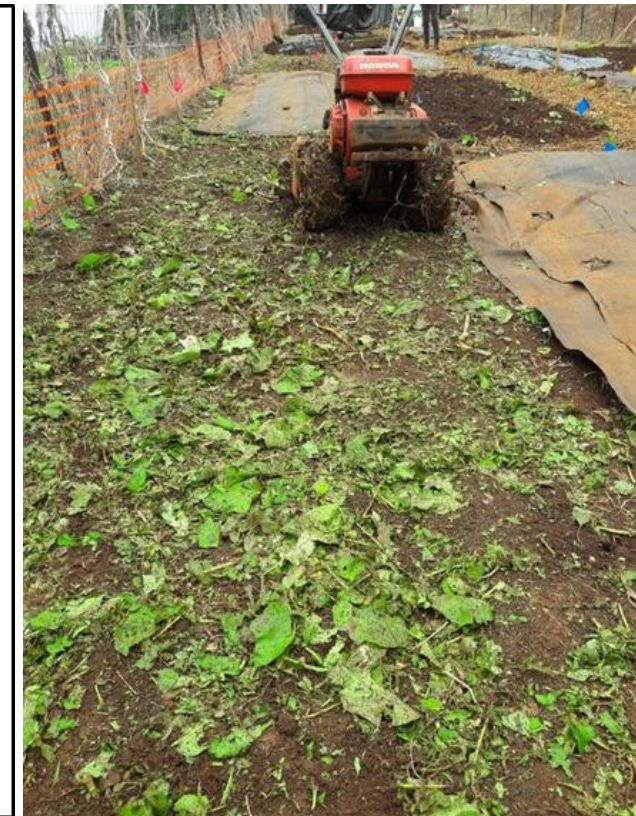
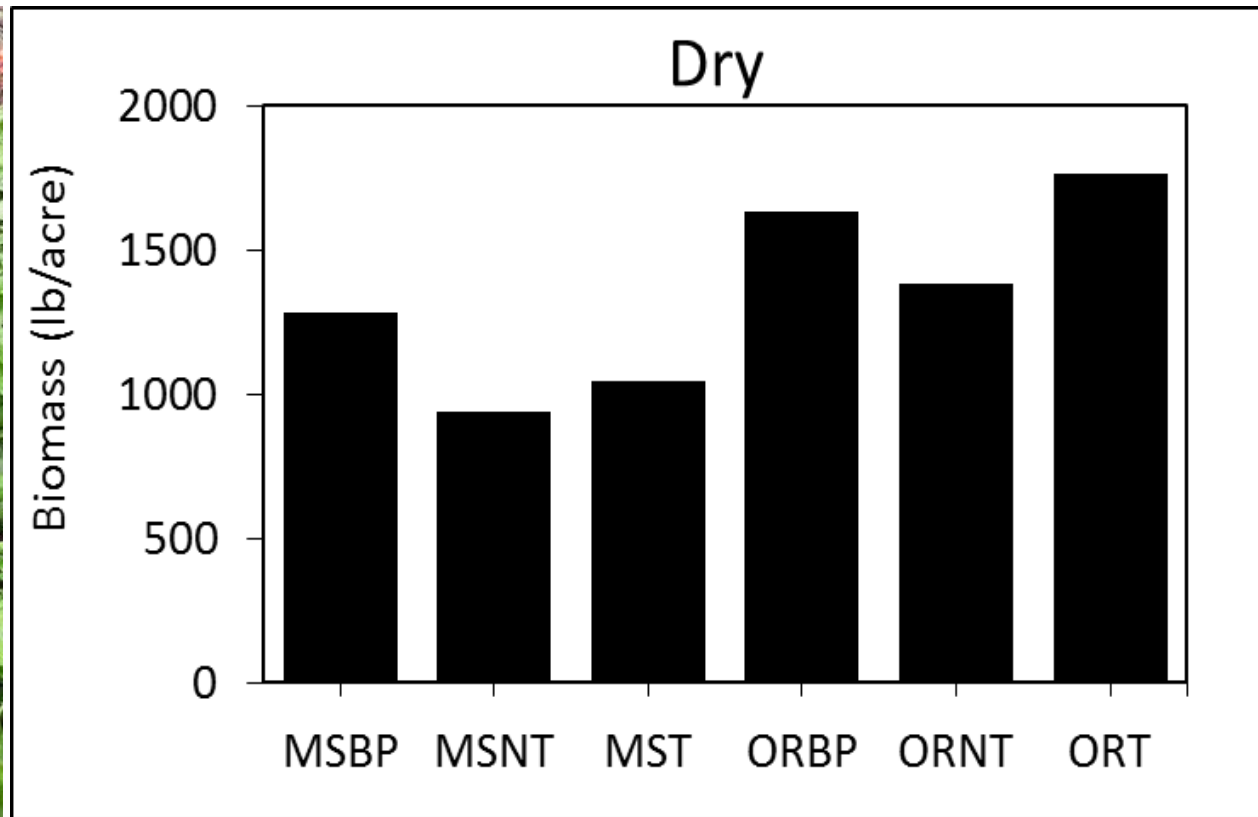
7 Treatments

- 1) ORT=oil radish + weed whack + till
- 2) ORBP=oil radish + weed whack + till + black plastic
- 3) ORNT=oil radish + sickle + weed mat (=NT)

- 4) MST=mustard + weed whack + till
- 5) MSBP=mustard + weed whack + till + black plastic
- 6) MSNT=mustard+sickle + weed mat (NT)
- 7) BG=Bare ground

Materials and methods

Biomass production



- 1) ORT=oil radish + weed whack + till; 2) ORBP=oil radish + weed whack + till + black plastic; 3) ORNT=oil radish + sickle + weed mat; 4) MST=mustard + weed whack + till; 5) MSBP= mustard + weed whack + till + black plastic; 6) MSNT=mustard + sickle + weed mat; 7) Bare ground control

Materials and methods

Cover crop termination and biofumigation



1 week after covering weed mat

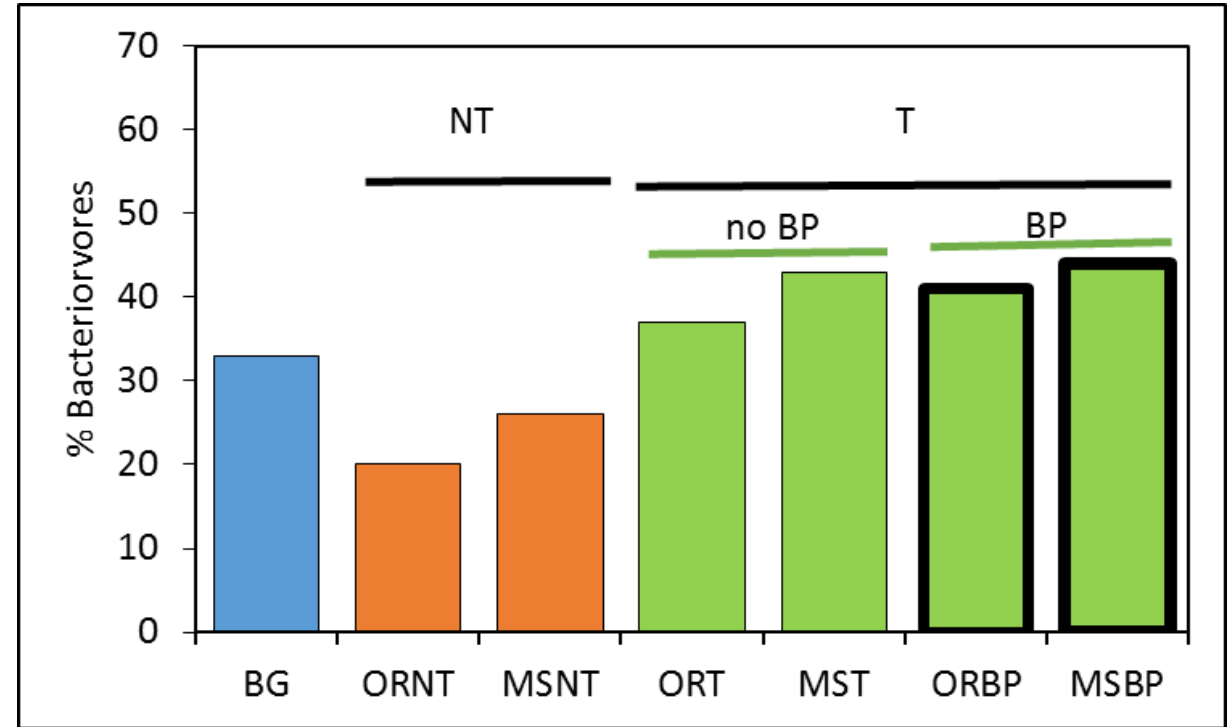
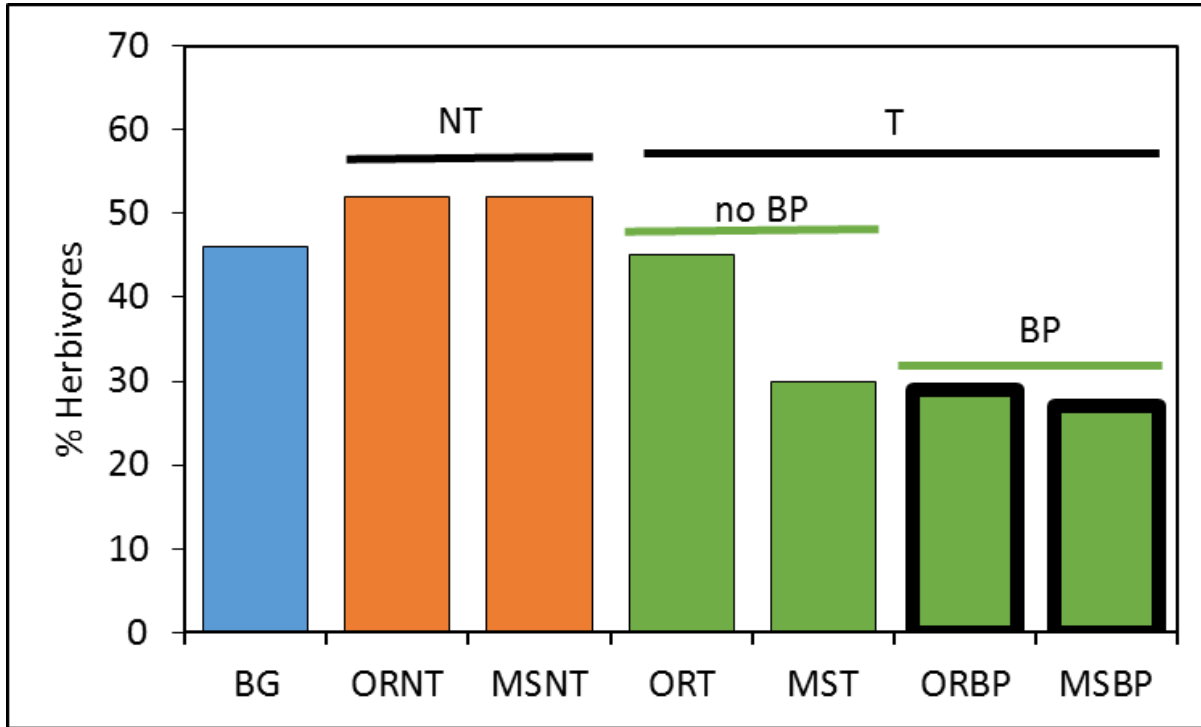


1 week after covering black plastic



'Felix' zucchini transplanted at 3 ft spacing

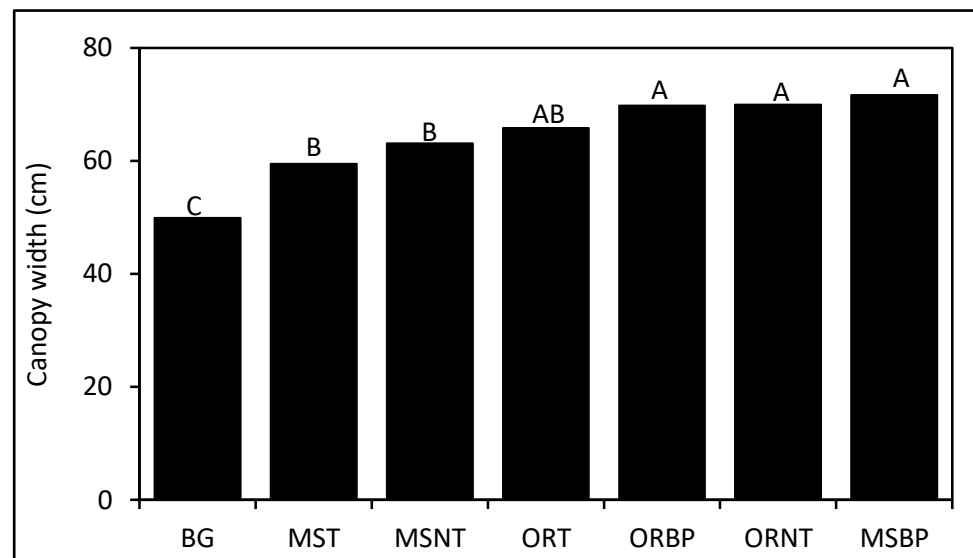
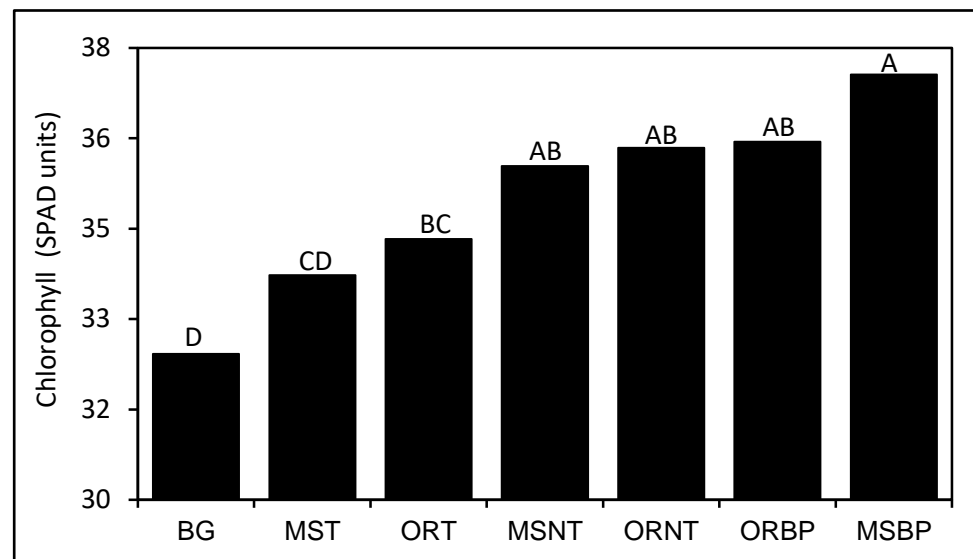
Biofumigation effects of oil radish and mustard on nematodes



1) ORT=oil radish + weed whack + till; 2) ORBP=oil radish + weed whack + till + black plastic; 3) ORNT=oil radish + sickle + weed mat; 4) MST=mustard + weed whack + till; 5) MSBP= mustard + weed whack + till + black plastic; 6) MSNT=mustard + sickle + weed mat; 7) Bare ground control

Plant growth after incorporation of radish and mustard green manures

2 weeks after planting



Conclusions

- 'Sodbuster' oil radish is a potential conventional trap crop and a good biofumigant cultivar against root-knot and reniform nematodes.
- Terminating oil radish at 4 weeks reduced galling on pumpkin and increased the total fruit weight (**74%**).
- Weed whacking oil radish or mustard + till + covering black plastic for 1 week reduced plant-parasitic nematodes by **39%**.

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