### Will enhancement of biofumigation effect of brassica cover crops against plantparasitic nematodes compromise their soil health promoting effect?

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## **Economic Importance of Plant-parasitic Nematodes**

- > \$100 billion/yr loss worldwide (\$10 billion loss in USA).
- > Nematicides pose environment concerns and many are phasing out.







### **Biofumigation** against plant-parasitic nematodes



Radish and mustard -- glucosinolates



### Oil radish terminated by tilling at 4 weeks after cover cropping



when terminated only by tilling without tissue maceration.



'Sodbuster' Oil radish

## **Objectives**



'Caliente 199' brown mustard More glucosinolates

Compare different termination methods of oil radish and mustard cover crops on:

- 1. biofumigation effect against plant-parasitic nematodes, and
- 2. soil health measured using free-living nematodes as bioindicators

# **Characteristics of Soil Health**

- High biodiversity
- Maintenance of soil nutrient cycling
- Suppression of multiple pests and pathogens
- Stability to disturbance or stress
- Improvement of plant health



# **Materials and Methods**

Experimental design: 7 treatments with 4 replications in RCBD.

Seeding: 10 lb/acre





#### **Treatments:**

ORNT = oil radish + sickle + weed mat; ORT = oil radish + line trim + till; ORBP = oil radish + line trim + till + black plastic;



MSNT = mustard + sickle + weed mat; MST = mustard + line trim + till; MSBP = mustard + line trim + till + black plastic; BG = bare ground fallow



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# **Objectives**



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Compare different termination methods of oil radish and mustard cover crops on

- J. biofumigation effect against plant-parasitic nematodes, and
  - 2. soil health measured using free-living nematodes as bioindicators

# **Results**

## **Biofumigation against Plant-parasitic Nematodes**

(repeated measures over 2 months; n = 84)



ORNT = oil radish + sickle + weed mat; ORT = oil radish + line trim + till; ORBP = oil radish + line trim + till + black plastic; MSNT = mustard + sickle + weed mat;

MST = mustard + line trim + till;

MSBP = mustard + line trim + till + black plastic;

BG = bare ground fallow

# **Results**



**Root Gall Index** (n = 4, *P* = 0.0403)

ORNT = oil radish + sickle + weed mat; ORT = oil radish + line trim + till; ORBP = oil radish + line trim + till + black plastic;

VISINI = MUSIAIO + SICKIE + Weed ma

MST = mustard + line trim + till;

MSBP = mustard + line trim + till + black plastic;

BG = bare ground fallow

# **Results** Did biofumigation compromise Soil Health?



- Suppression of multiple pests and pathogens
- Maintenance of soil nutrient cycling
- High biodiversity
- Stability to disturbance or stress
- Improvement of plant health

# Results

### **Bacterial Feeding Nematodes**

(Repeated measures over 2 months; N =84; P = 0.3056)



ORNT = oil radish + sickle + weed mat;<br/>ORT = oil radish + line trim + till;MSNT = mustard + sickle + weed mat;<br/>MST = mustard + line trim + till;<br/>MST = mustard + line trim + till;<br/>MSBP = mustard + line trim + till + black plastic;<br/>BG = bare ground fallow

## Results

Nematode diversity (Repeated measures over 2 months; N = 84; P = 0.0725)



ORNT = oil radish + sickle + weed mat; ORT = oil radish + line trim + till; ORBP = oil radish + line trim + till + black plastic;

MSNT = mustard + sickle + weed mat;

MST = mustard + line trim + till;

MSBP = mustard + line trim + till + black plastic; BG = bare ground fallow



- Suppression of multiple pests and pathogens
- Maintenance of soil nutrient cycling
- > High biodiversity
- Stability to disturbance or stress
- Improvement of plant health

## Results

(Repeated measures over 2 months; N = 84; P = 0.9963)



ORNT = oil radish + sickle + weed mat;NORT = oil radish + line trim + till;ORBP = oil radish + line trim + till + black plastic;N

MSNT = mustard + sickle + weed mat;

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MST = mustard + line trim + till;
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MSBP = mustard + line trim + till + black plastic; BG = bare ground fallow



- Suppression of multiple pests and pathogens
- Maintenance of soil nutrient cycling
- > High biodiversity
- Stability to disturbance or stress
- Improvement of plant health

### Results





ORNT = oil radish + sickle + weed mat; ORT = oil radish + line trim + till; ORBP = oil radish + line trim + till + black plastic; Zucchini yield (N = 4; P > 0.05)



- MSNT = mustard + sickle + weed mat;
  - MST = mustard + line trim + till;
- MSBP = mustard + line trim + till + black plastic;
  - BG = bare ground fallow

# Conclusions

- Covering macerated brassica cover crop residues with black plastic enhance their biofumigation effects against root-knot (MSBP and ORBP) and reniform nematodes (MSBP).
- This biofumigation effect against plant-parasitic nematodes did not compromise the soil health conditions.
  - Diversity of beneficial nematodes were higher in MSBP than BG.
- Although yields were not different among treatments, zucchini plant growth was higher in MSBP compared to BG.

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# **Soil temperature**

### Measured over 7 days

P = 0.39



Average biomass (kg/ha): Oil radish = 1788.02 Mustard = 1220.89

BG = bare ground control; NT = no-till; BP = black plastic