

# *Natural Farming: More Room for Growth*



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# *Korean Natural Farming (KNF)*



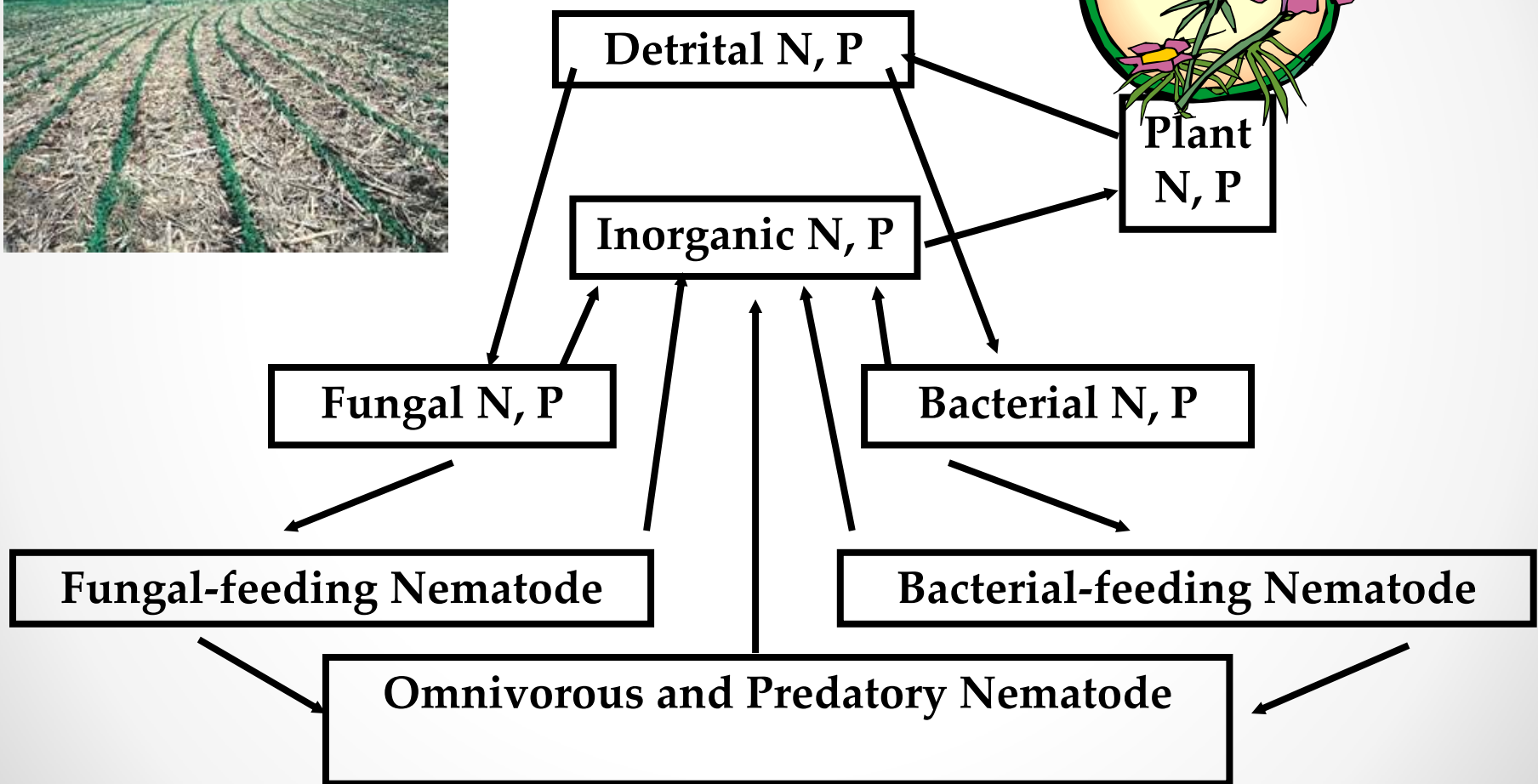
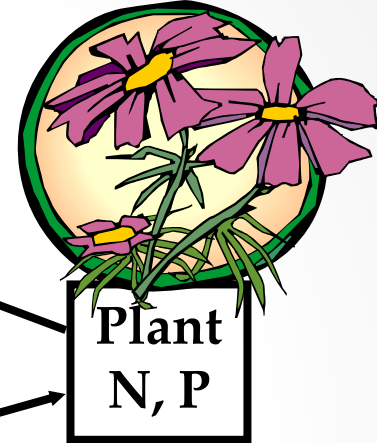
- KNF involves collecting and culturing indigenous microorganisms (IMO) from natural area and reintroducing them into a cropping system that had been disturbed by conventional farming practices.

The concept is to have IMO to enhance soil nutrient cycling, while helping the plants to produce healthy root system for efficient nutrient uptake.

- Nutrients extracted from various fermented farm wastes are foliar sprayed weekly as plant nutrient inputs.

# Soil Nutrient Cycling

Crop Residues



(modified from Ingham *et al.*, 1985)

## *Summary from >10 field Trials*

1. Seven field trials comparing KNF to organic or synthetic fertilizer treatments.
2. Two field trials comparing with or without mulching
3. One field trial comparing IMO4 to other commercial soil inoculants.
4. Some field trials fail due to heavy pests (especially seedlings infested with mites or fields colonized by weeds).

# *Comparing KNF to Organic or Conventional Fertilizer Treatments*

Farm	Crop(s)	Plot size (# plots/treatment)	Surface mulch
Farm #1	soybean	8 × 20 ft <sup>2</sup> (4/treatment)	Sunn hemp cover crop
Farm #2	kabocha squash	2 × 2 ft <sup>2</sup> (10/treatment)	Wood chips
Farm #3: Permaculture Farm	kale, beet, broccoli, onion, leek	4 × 100 ft <sup>2</sup> (2/treatment)	Macademia nut husks, other organic compost
Poamoho	Grape tomato	8 × 30 ft <sup>2</sup> (3/treatment)	Sunn hemp no-till farming
Kaneohe (WCC)	Grape tomato	4 × 10 ft <sup>2</sup>	Yard waste compost
Kula	Zucchini	10 × 10 ft <sup>2</sup>	Bamboo leaves
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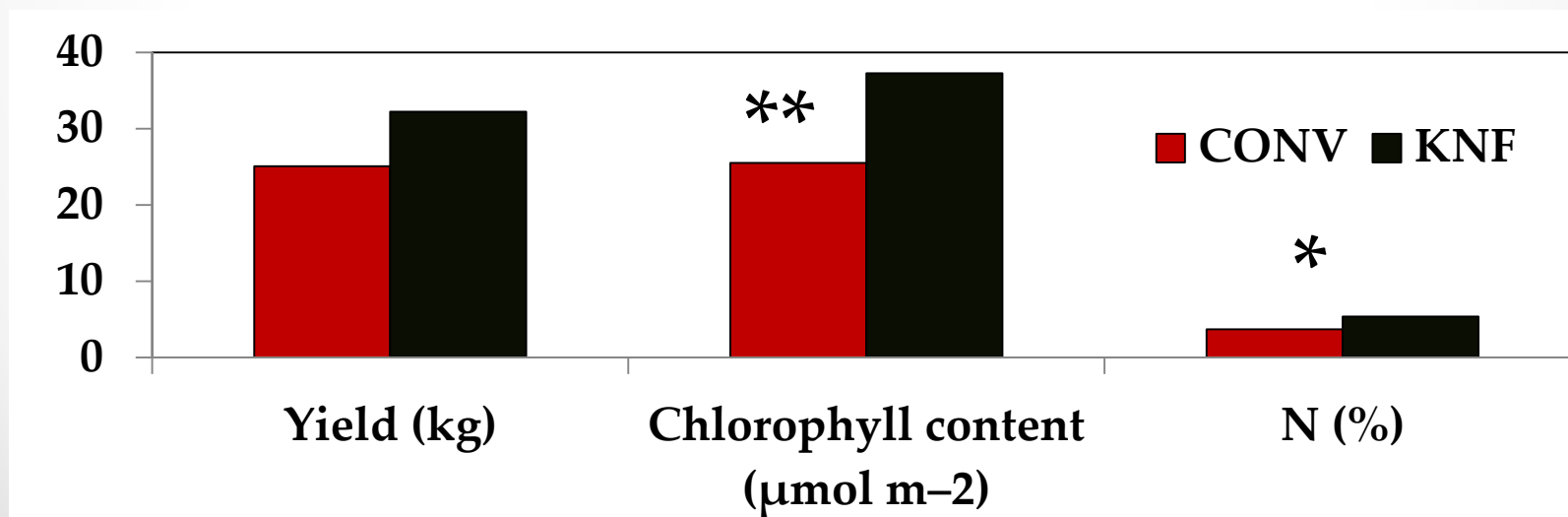


SPAD  
Chlorophyll  
meter



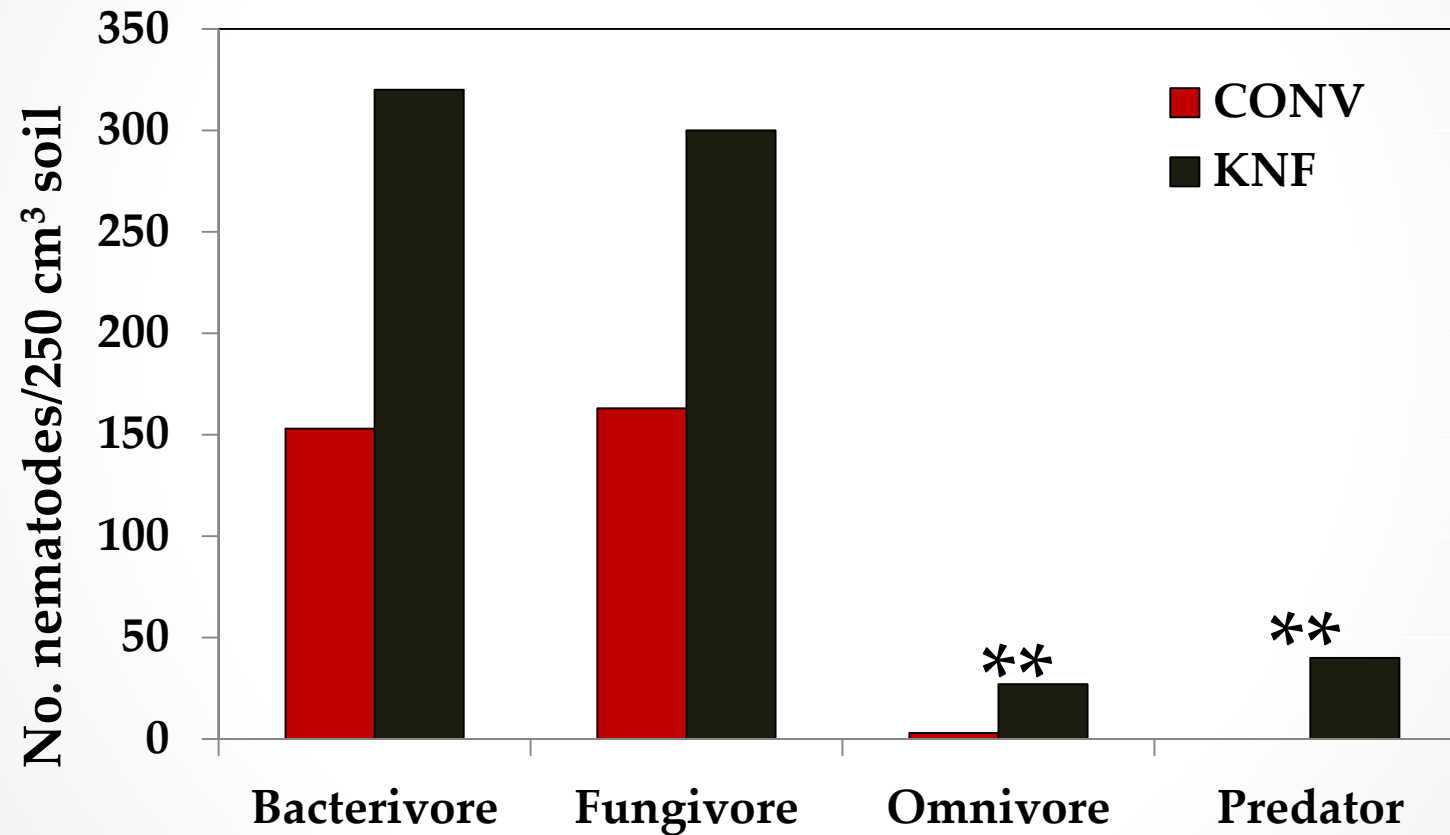
## *Farm #1 (Soybean)*

### *KNF improve Plant Health*



# *Farm #1 (Soybean)*

*KNF improve soil health*

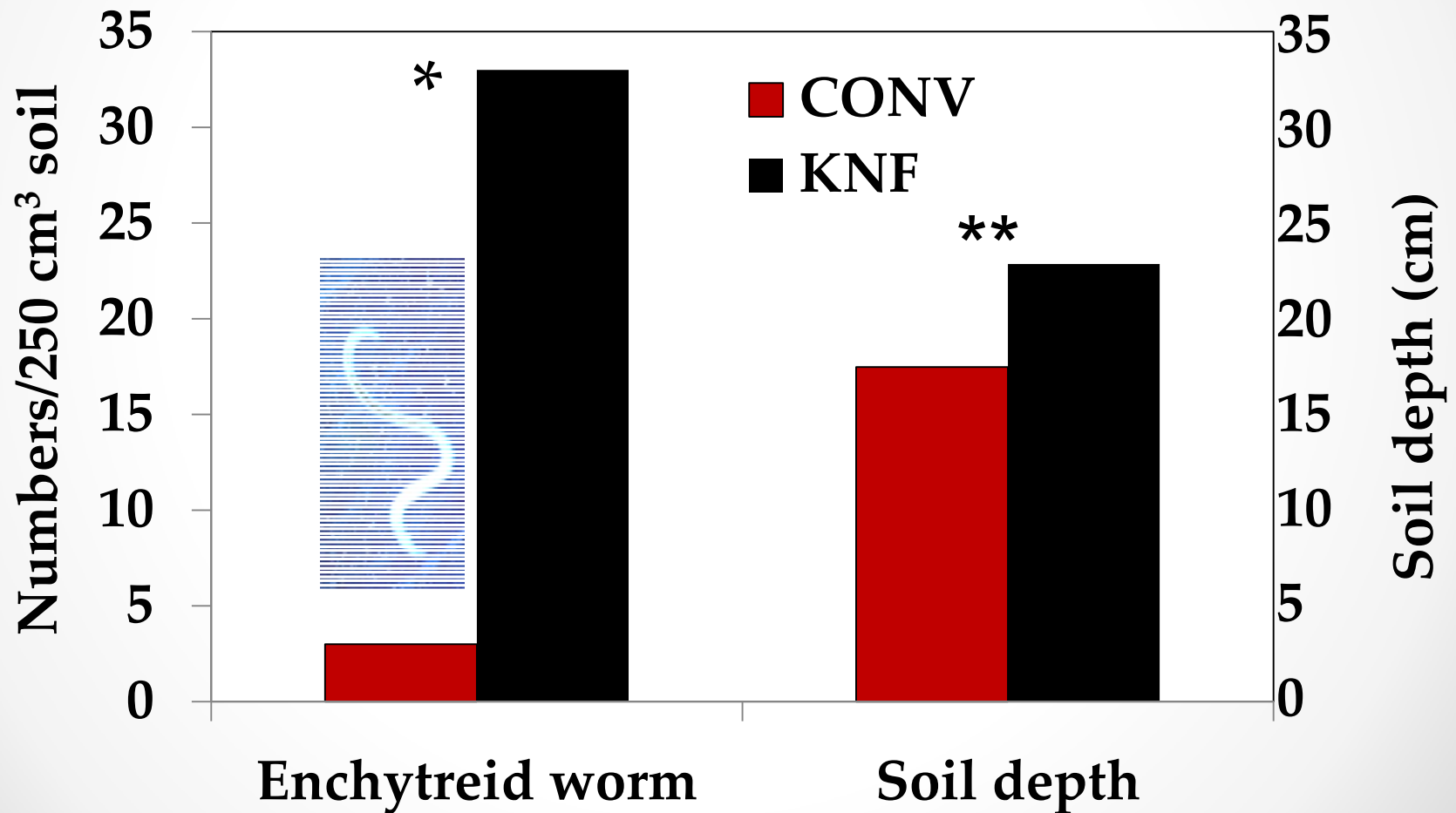




Soil compaction tester

## *Farm #1 (Soybean)*

### *KNF reduced soil compaction*



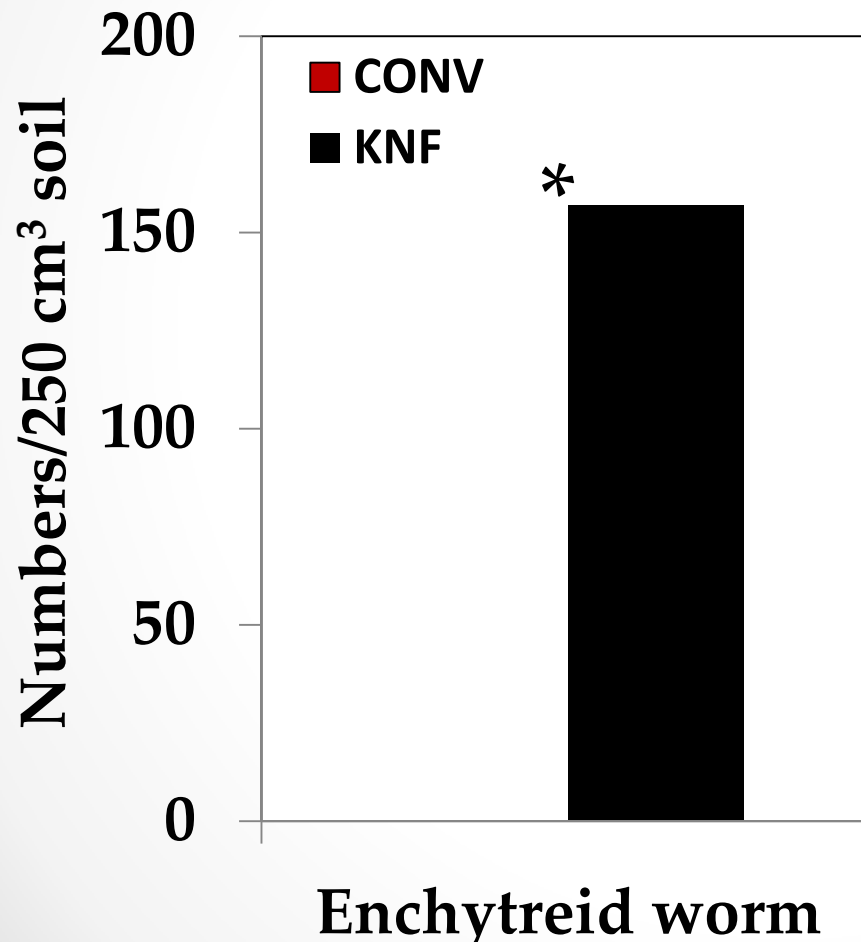


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## *Farm #2*

### *KNF improves Soil Tilth*



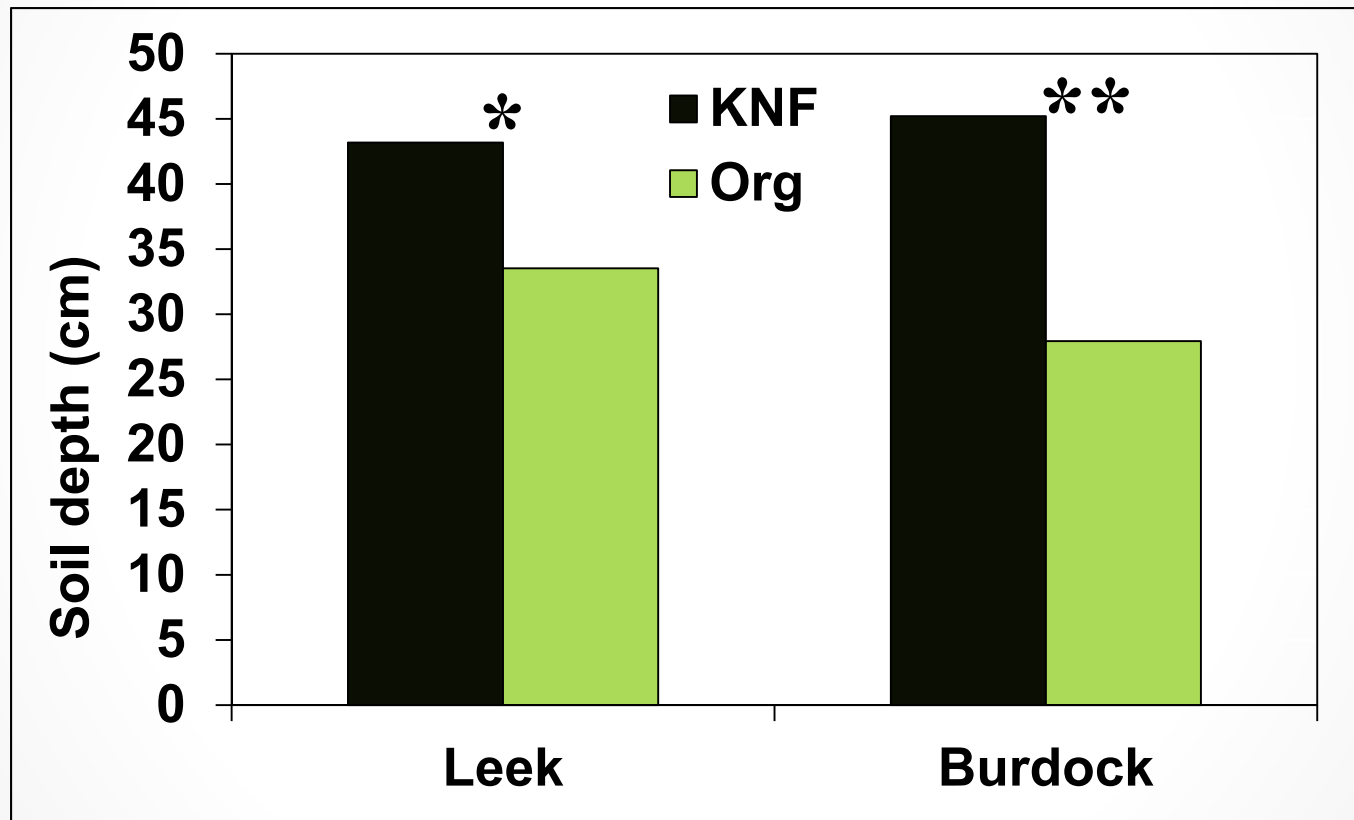
KNF also increased enchytreid worm that could contribute to better soil tilth in Farm #2.



## Farm #3



### Results (Soil Compaction)





# RMATRIX Research Project

## WCC Nursing Program Community Garden



● Prepare their own IMO & KNF inputs

### Cherry tomato trial



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# Experiment

## 1. KNF

Korean Natural Farming, IMO4 as preplant soil amendment, followed by weekly foliar nutrient sprays (alternating Type II and Type III solution)

## 2. Organic (ORG)

Greenhouse Hawaii Inc. vericompost worm casting as preplant soil amendment, followed by weekly vermicompost tea drenching.

## 3. Conventional (CONV)

Weekly liquid fertilizer 16-16-16 soil drenching.





# *Plant growth are slower in KNF plots at early planting* (~ 6 week after planting)

Plants are lighter green

Plants are darker green



Treatment	Height (inches)
CONV	16.00
ORG	16.17
KNF	11.50



• CONV

ORG

KNF •





CONV



ORG



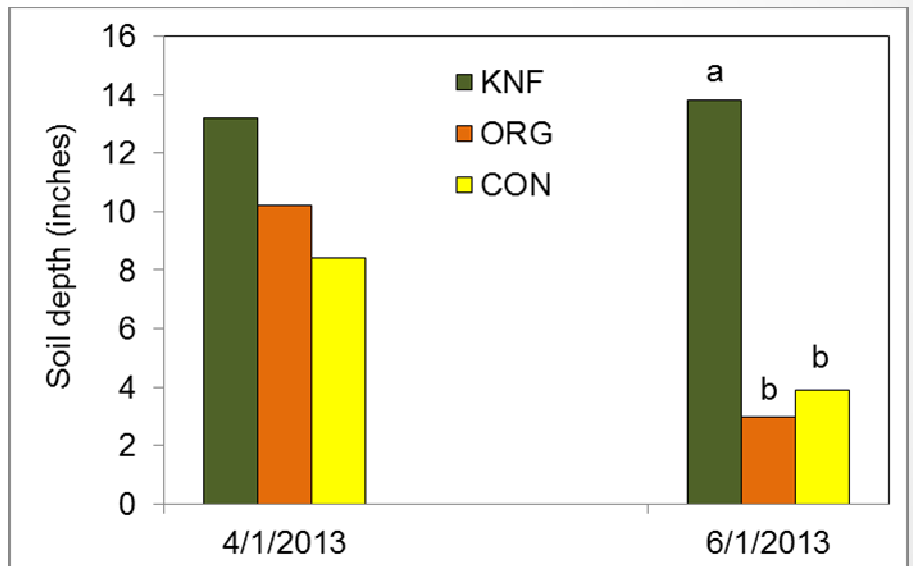
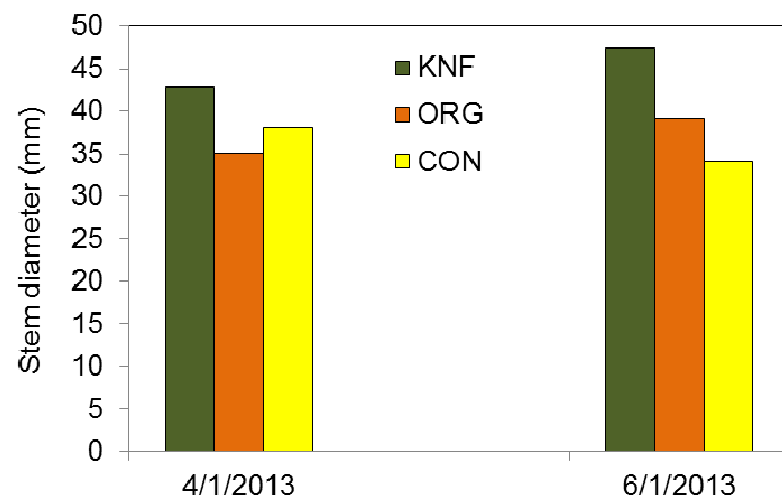
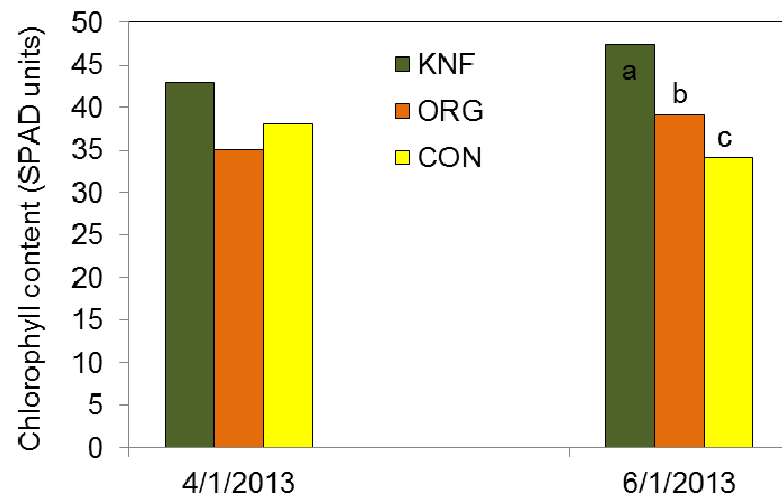
KNF

~ 3 months after planting tomato 'Felicity'

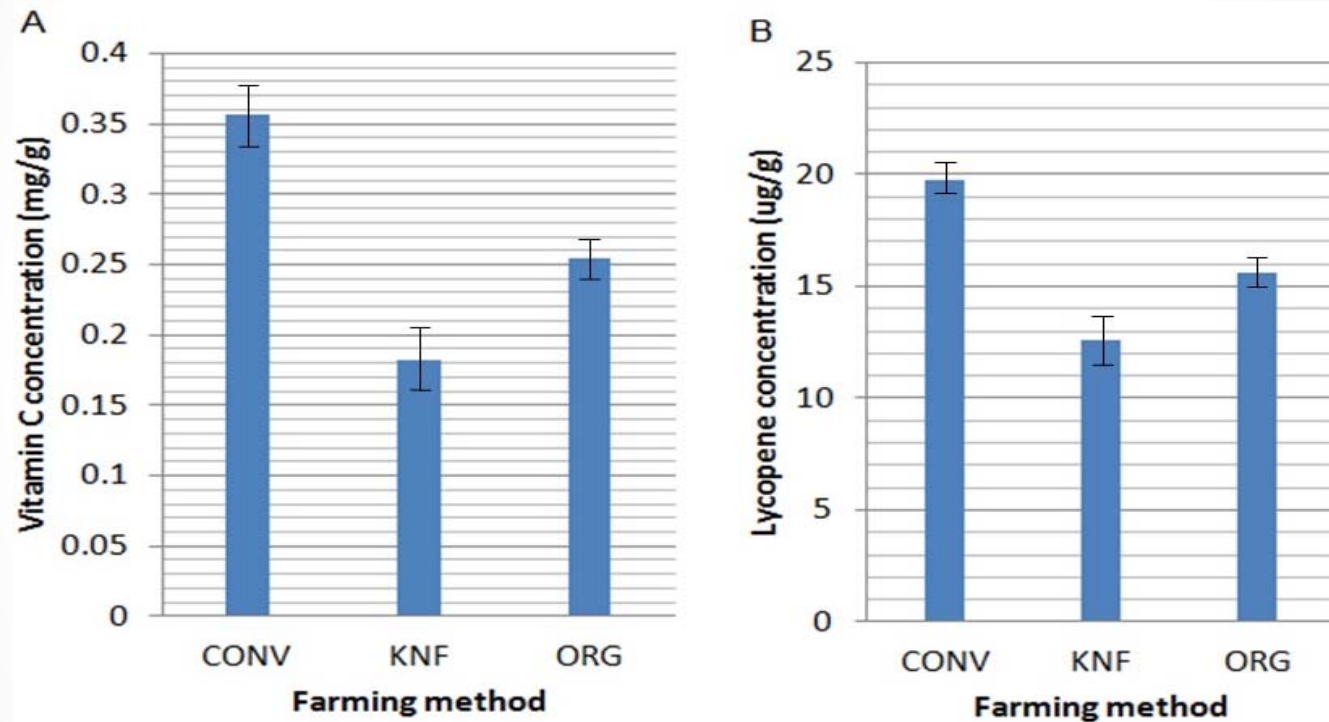
- Plant growth of tomato in KNF was more vigorous and remained productive over a longer period of time as compared to ORG and CONV.
- Plants in ORG and CONV were declined by early blight and Septoria leaf spot earlier than that in KNF.

# KNF Eventually Resulted in Healthier Plant & Soil

(3 months after planting)



# Effects of KNF on Fruit Quality



- KNF practice did not result in higher tomato fruit quality. The conventional farming method produced tomatoes with the highest amount of vitamin C (A) and lycopene (B)

(Wen and Bingham, 2014)





## *KNF did not increase Fruit Nutrient Contents*

Nutrient	n	KNF	ORG	CONV
N (%)	3	1.55 a	2.18 a	1.55 a
P (%)	3	0.25 b	0.42 a	0.34 ab
K (%)	3	3.22 b	4.01 a	3.26 ab
C (%)	3	42.30 a	42.77 a	42.79 a
Ca (%)	3	0.12 a	0.11 a	0.12 a
Mg (%)	3	0.16 b	0.21 a	0.17 ab
Na (%)	3	0.05 b	0.07 a	0.05 b
Fe (ppm)	3	47.00 a	47.33 a	42.00 a
Mn (ppm)	3	8.00 b	12.67 a	8.00 b
Zn (ppm)	3	19.33 b	23.67 a	17.67 b
Cu (ppm)	3	7.67 a	8.00 a	6.00 b
B (ppm)	3	10.67 b	14.00 a	12.33ab
Crude Fiber (%)	3	12.44 b	14.10 a	14.23 a
Sugar (brix)	4	6.00 ab	5.58 b	6.62 a
Fruit weight/fruit	6 (10 sub)	14.88 a	10.79 b	10.47 b

- Although KNF practice resulted in heavier tomato fruits, it did not produce fruits with higher nutrient and sugar contents.

## *KNF Trials at Kula*



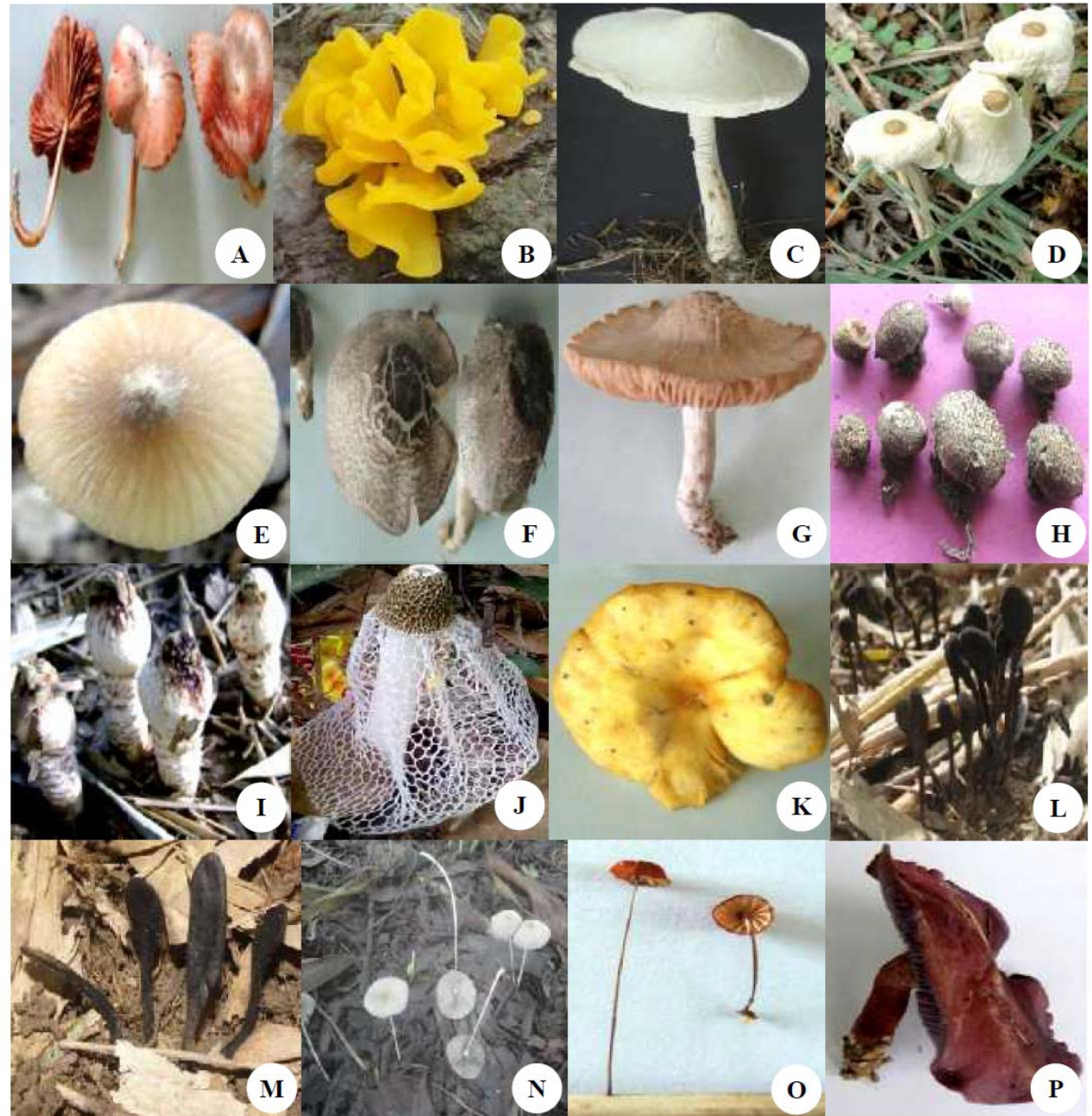
Abundant of bamboo trees, so we use bamboo leaves as mulch



Fungal diversity  
associated  
with bamboo  
litter from  
Bambusetum  
of Rain Forest  
Research  
Institute,  
Northern India

Thus IMO4 could  
contain lots of  
saprophytic fungi

(Kumar et al., 2013;  
Biodiversitas 14: 79-88 )



**Figure 3.** A. *Entoloma rhodopolium*, B. *Dacryopinax spathularia*, C. *Cystoderma carcharias*, D. *Volvariella murinella*, E. *Entoloma cetratum*, F. *Agaricus augustus*, G. *Entoloma lividoalbum*, H. *Morganella pyriformis*, I. *Termitomyces albuminosus*, J. *Dictyophora indusiata*, K. *Clitocybe phyllophila*, L. *Geoglossum deforme*, M. *Geoglossum fallax*, N. *Coprinus plicatilis*, O. *Marasmius siccus*, P. *Clitocybe nuda*



# ***KNF Trials at Kula***

**KNF = Korean Natural Farming ORG = Organic fertilizer  
CONV=Synthetic fertilizer with urea**

Field  
history:  
Fallow  
for > 10  
years



Seedlings  
in CONV  
& ORG  
received  
fertilizer  
drench,  
but KNF  
was not

Bamboo  
leaves as  
surface  
mulch  
for KNF

**Trial I = Zucchini**

**Trial II = Tomato**

ORG and CONV seedlings received fertilizer on seedling tray, KNF seedlings only received SES solution prior to planting



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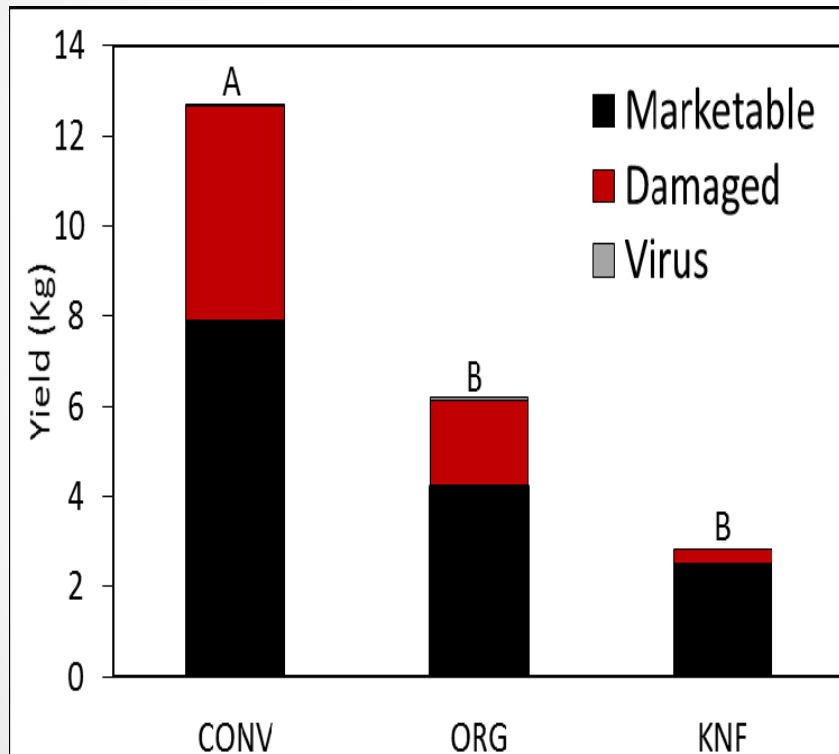
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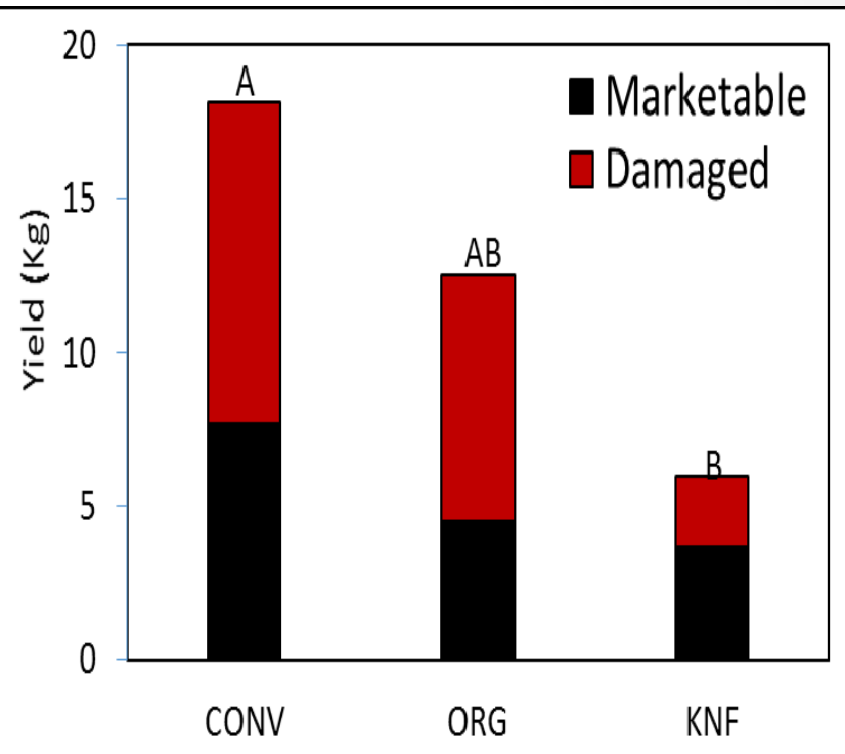
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# *Crop yield was poorer in KNF*

**2014 Zucchini**

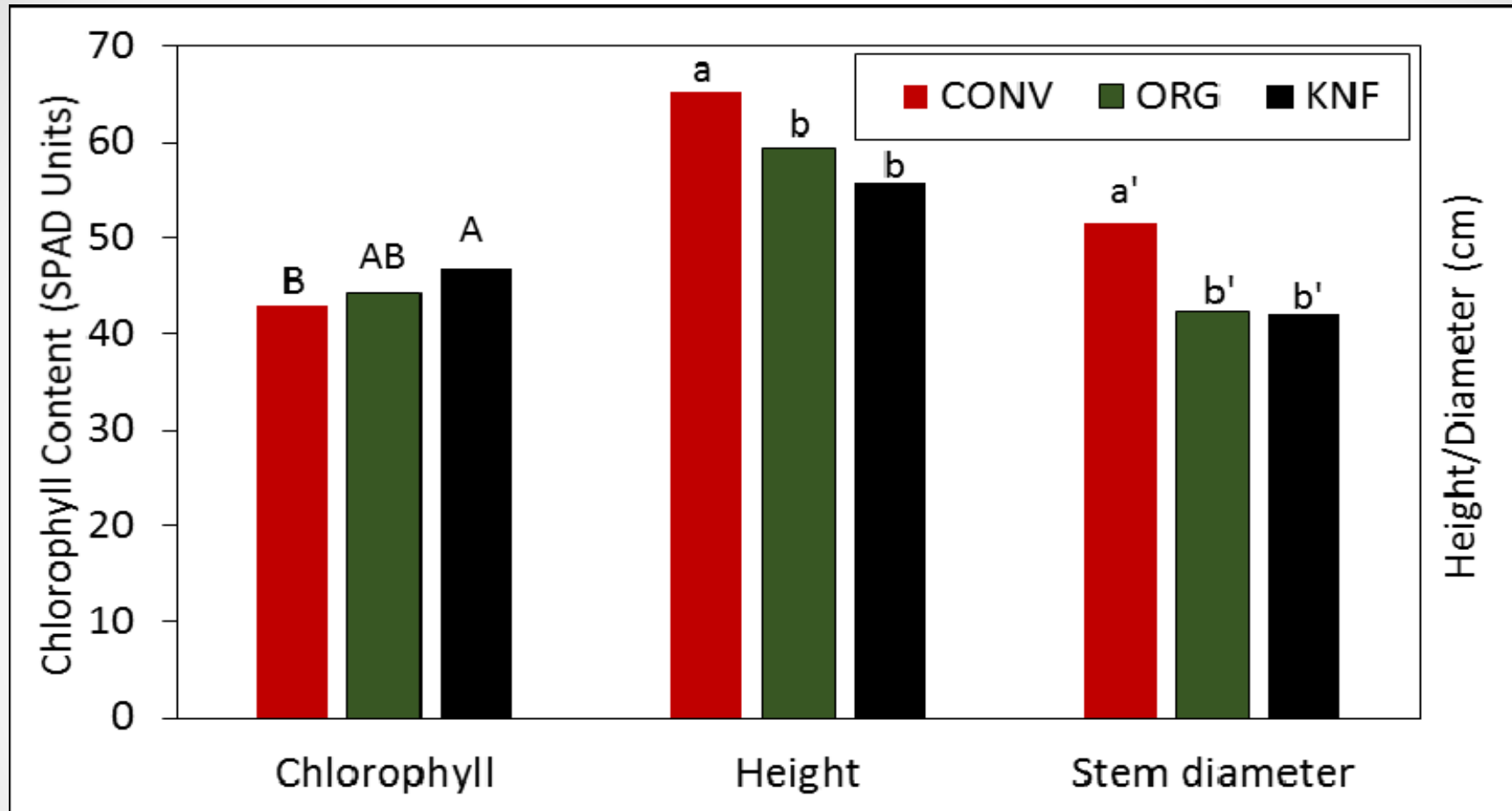


**2015 Tomato**



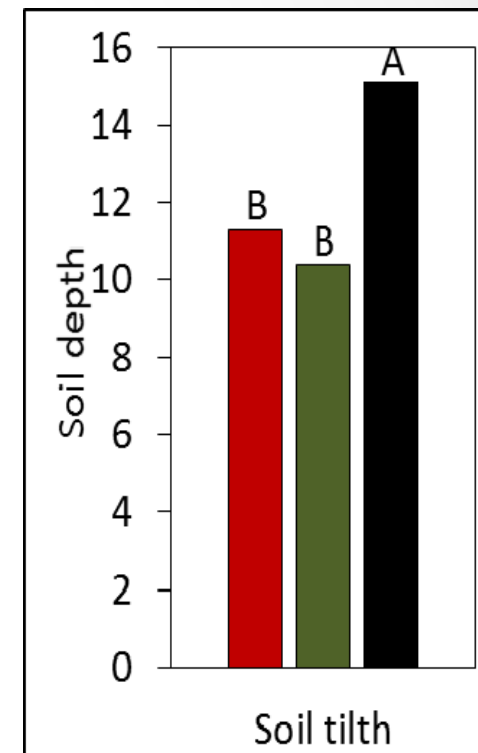
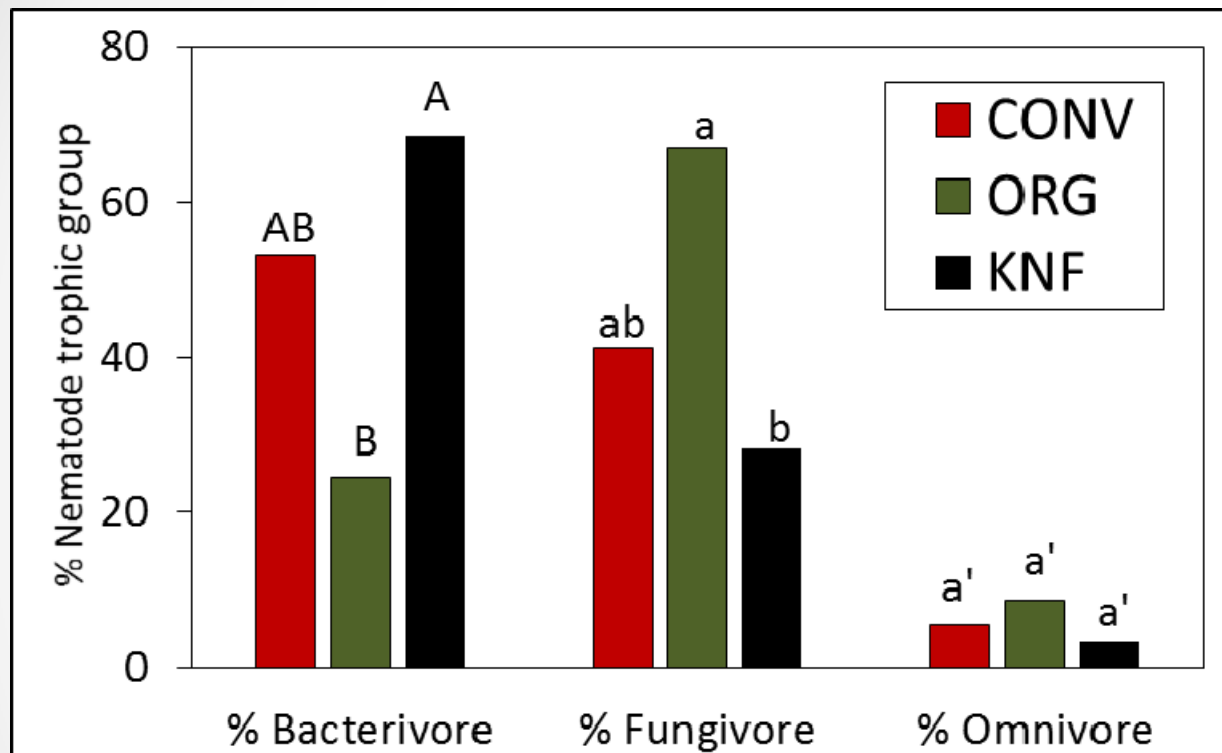


## *Plant Growth Parameters at Harvest*



Plant growth in KNF treatment was slow, lack of seedling treatments delayed crop development. Plants were greener in KNF at the end of the trial. After 2 months of growth, fruitflies and pickle worm damage were already too severe, extending the harvesting period in KNF could not compliment the yield loss.

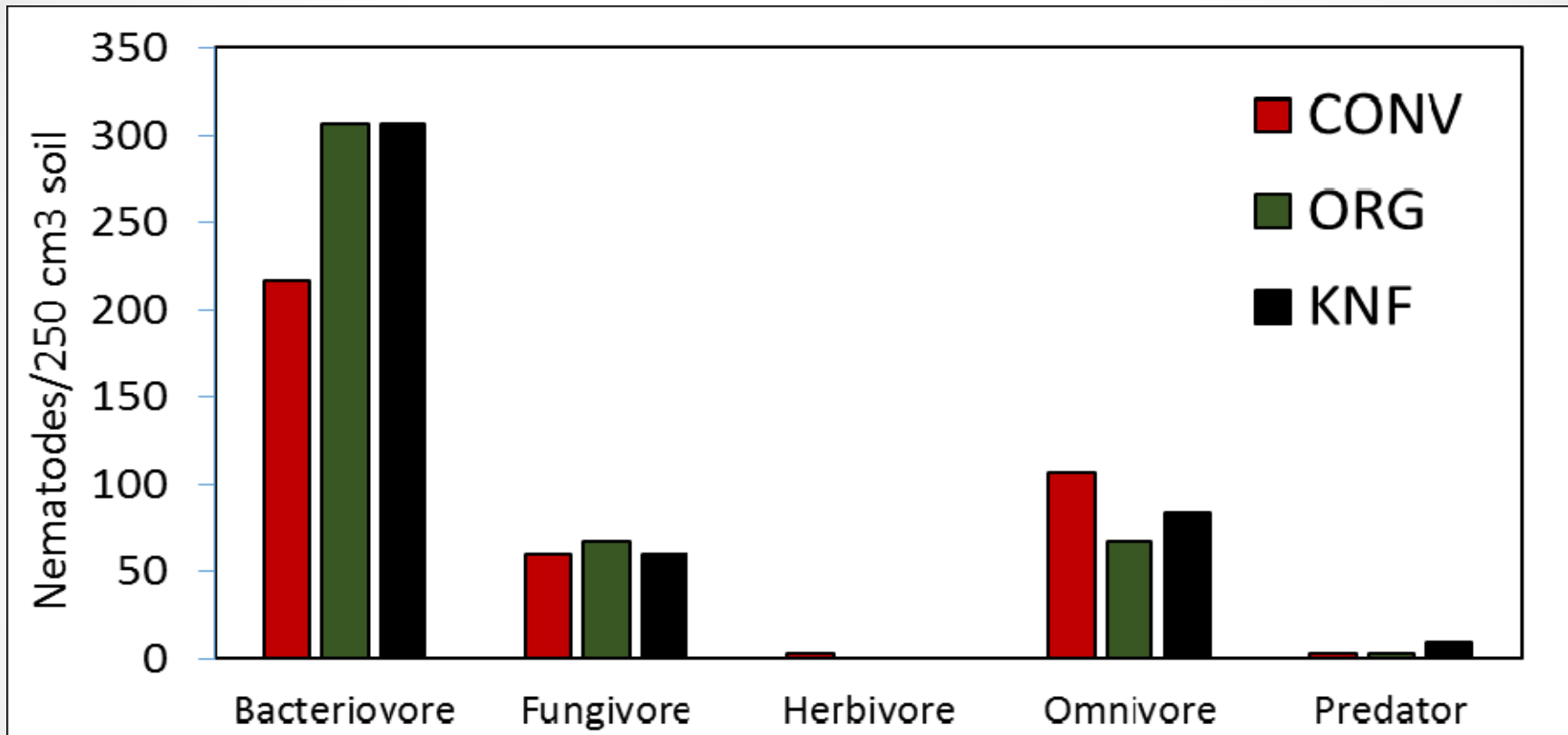
# *Soil Health Assay (Kula Trial I)*



- The field plot was fallow for long period of time without much crop residues prior to the experiment. Overall, nematode abundance was very low in Trial I, indicating a stressful soil food web.
- KNF treatment resulted in higher % of bacterivorous nematodes, indicating a more enriched soil food web. KNF also improved soil tilth within one cropping cycle. •



## *Soil Health Assay (Kula Trial II)*

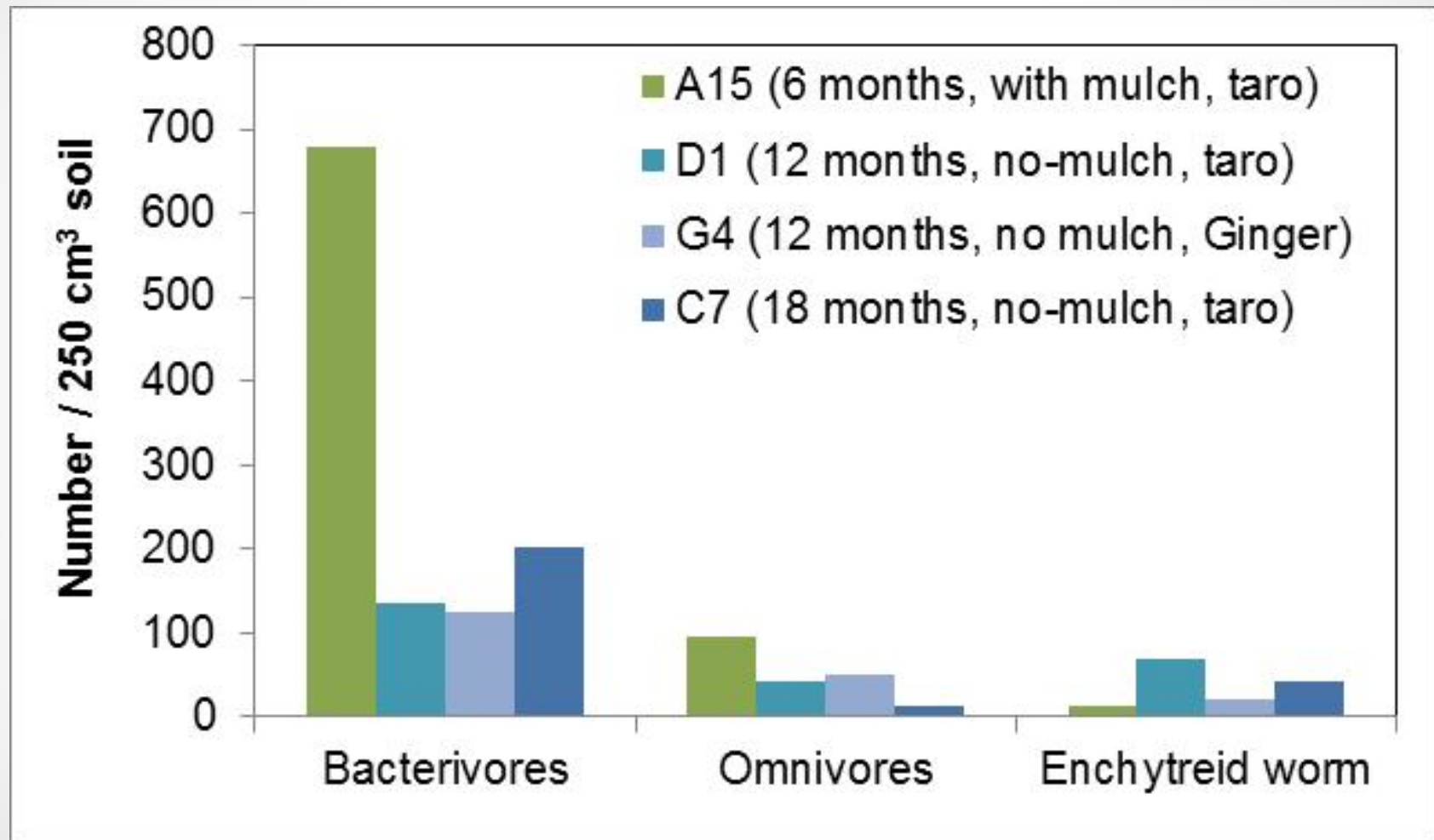


- Regardless of soil treatments, soil health is better in Trial II than in Trial I.
- No significant difference was detected among treatments. Bamboo mulch is not a good mulch to use for a system that rely on recycling of organic residue.

## *Summary from >10 field Trials*

1. Seven field trials comparing KNF to organic or synthetic fertilizer treatments.
- ✓ 2. Two field trials comparing with or without mulching
3. One field trial comparing IMO4 to other commercial soil inoculants.
4. Some field trials fail due to heavy pests (especially seedlings infested with mites or fields colonized by weeds).

## *Farm #4 (Effects of mulch on KNF)*



- Effect of KNF is strongly affected by mulch types.
- Mulch used was yard waste compost.

# *Poamoho Trial:*

## *Integrating No-till Cover Cropping with KNF*

No-till Sunn hemp (SH)

vs

Tilled & Weed Mat (WM)

1. KNF+ SH
2. KNF + WM
3. CONV + SH
4. CONV + WM

Conv = Organic fertilizer  
(Chicken pellets @ 180  
lb N /acre)





# *No-till Cover Cropping with KNF*

Sunn hemp grown  
from May-July, 2012  
produced 14.7  
tons/acre of  
biomass.



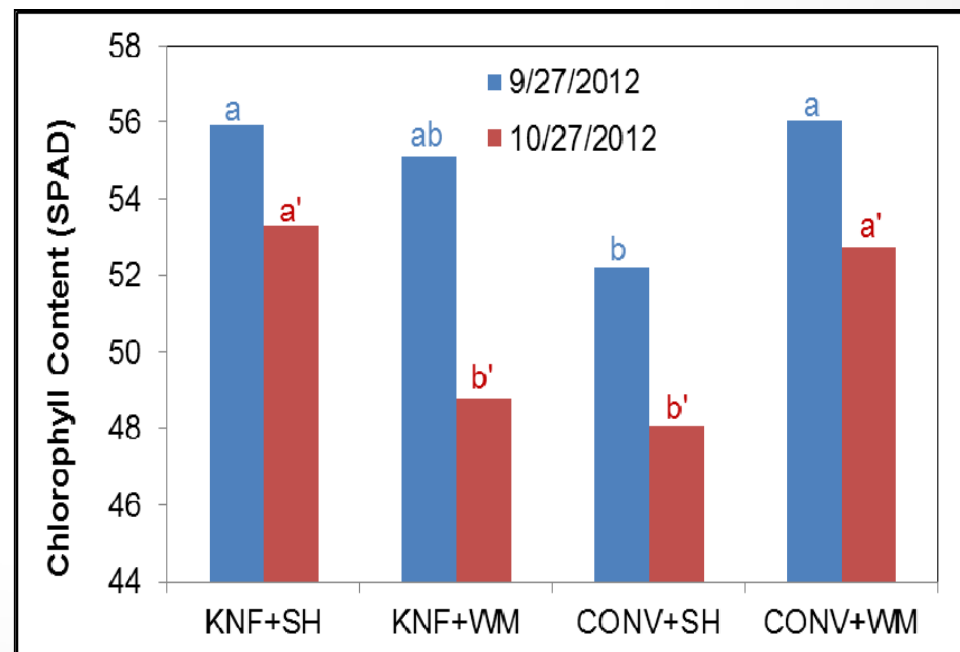
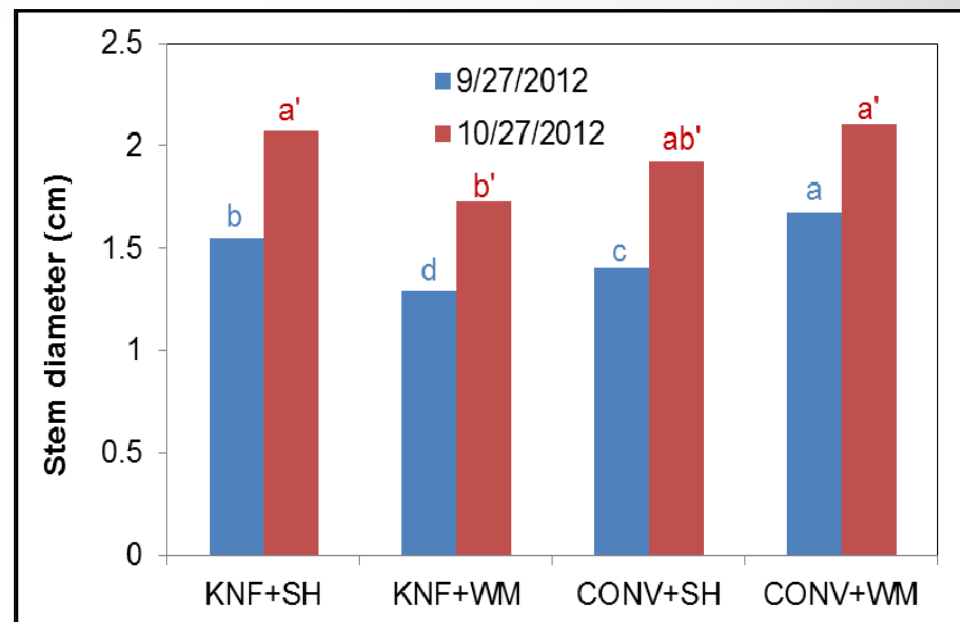
Roller crimper =  
no-till equipment for  
organic farming

*KNF supported plant growth better in SH than in Weed mat plots*



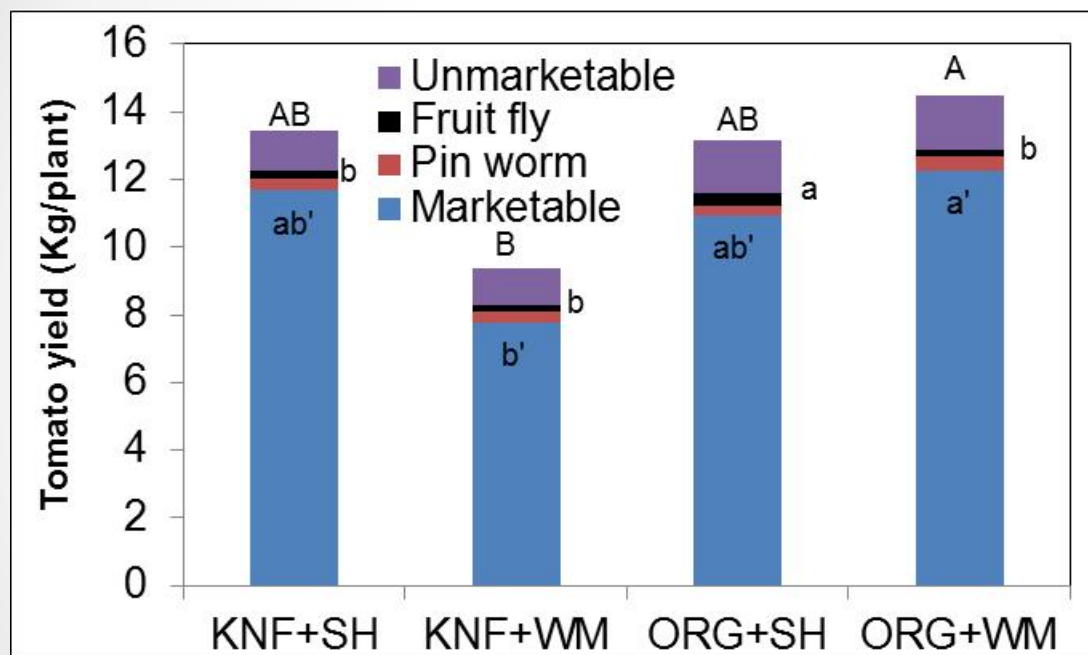
KNF + SH at 3 months after planting

- 



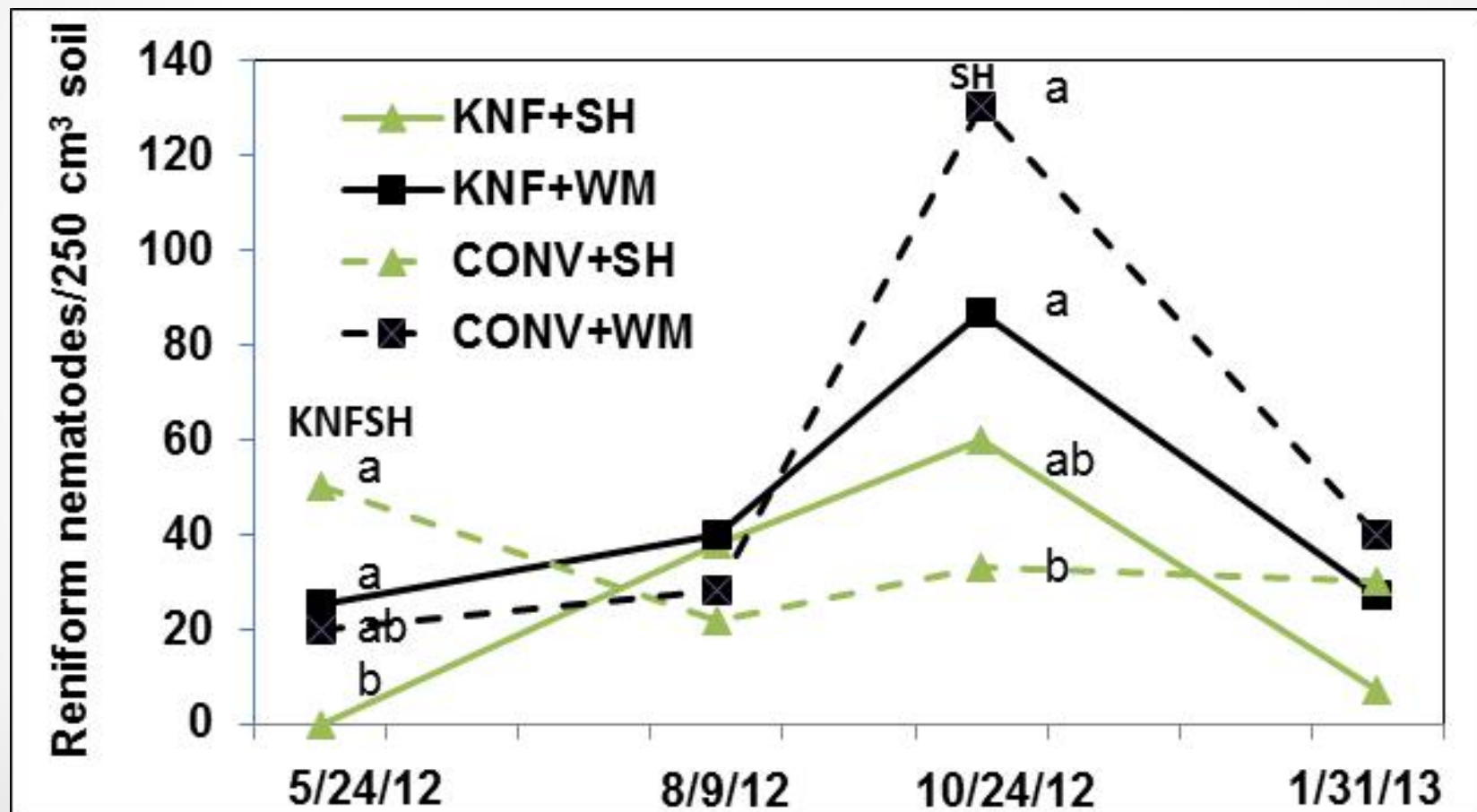


# Poamoho KNF Project



- Tomato Yield in KNF+SH was comparable to using organic fertilizer + weed mat.
- KNF worked better if integrated with no-till farming + organic mulching.

## *Sunn Hemp Suppress Plant-parasitic nematodes but not KNF*





- Considering the amount of compost (IMO4) recommended at 30 lb/1000 ft<sup>2</sup> (0.65 tons/acre), the practice of natural farming (NF) is relatively feasible and economical.
- NF practitioners should consult experience/certified NF instructors to conduct NF correctly.
- NF includes: inoculating soil with IMO4 prepared regionally using field soil, mulching, reduce tillage, and foliar spray.
- However, inconsistent results in producing comparable yield to standard farming practice (organic or conventional) still occur despite proper procedures.
- This brought our attention to basic concept of Natural Farming – recycling of farm waste.





## *Remark*

- NF should be conducted in areas with sufficient crop residues available from previous crop, cover cropping or mulching. If crop residues is not readily available from previous season, careful selection of mulching materials should be considered.
- IMO4 is prepared through mesophilic composting process so as to culture and preserve indigenous organisms associated with the compost, it is not meant to be a main nutrients source compare to thermophilic compost.
- While proper practice of NF could improve plant health, it is not a main approach to manage crop pests.
- Nutrient inputs to enhance seedling growth could speed up transplants growth, thus reducing pest exposure time in open field.
- As food producers, NF should follow best management practice (BMP) and comply with food safety.

# Acknowledgement

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Juan Castilo

Miriam Longs



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